

✿ 日本数学会

2014年度年会

# 英 文 サ マ リ 集

2014年3月

於 学習院大学



# 2014 日本数学会 年会プログラム

期 日 2014年3月15日(土)～3月18日(火)  
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	総 合 講 演 ( " ) 日本数学会賞春季賞受賞者……………(15:30～16:30) 溝 口 紀 子(東京学大教育)……………(16:45～17:45) 懇 親 会(目白倶楽部)……………(18:00～20:00)								
17日 (月)	代 数 学 9:30～12:00 14:15～15:00	函数解析学 9:30～12:00 14:15～15:00	実函数論 9:00～12:05 14:15～16:25	トポロジー 10:00～12:00 14:15～15:15	函数方程式論 9:00～12:00 14:15～16:15	統計数学 9:00～12:00	幾 何 学 10:00～11:50	無限可積分系 10:00～11:30 14:15～15:00	応用数学 9:00～12:00 14:30～16:30
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	企画特別講演 13:00～14:00								
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## 総 合 講 演

3月16日(日) 第I会場

日本数学会賞春季賞受賞者 ..... (15:30~16:30)

MSJ Spring Prize Winner

溝 口 紀 子 (東京学大教育) 非線形放物型方程式の爆発現象 ..... (16:45~17:45)

Noriko Mizoguchi Blow-up in nonlinear parabolic equations  
(Tokyo Gakugei Univ.)

概要 The blow-up of solutions has been one of the subjects most actively studied in nonlinear parabolic equations and systems for several decades. Various factors affect the determination of whether a solution blows up in finite time or exists globally in time. One needs to investigate the mathematical structures behind phenomena. It is very useful in the process to make use of methods in other fields in addition to analysis. I will give a talk about my recent results on the blow-up of solutions to nonlinear parabolic equations and systems.

## 企 画 特 別 講 演

3月15日(土)

第I会場

本 橋 洋 一 \* 双子素数予想 ..... (13:00~14:00)

(Finnish Acad. of Sci. & Letters)

Yoichi Motohashi The twin prime conjecture

(Finnish Acad. of Sci. & Letters)

概要 A spectacular development is going on in the theory of the distribution of primes. Luckily enough, I am witnessing the event as a contemporary specialist. The purpose of my talk is to share this excitement of mine with my audience. Any mathematical discovery is an eventual outcome of rich and long history of our cherished discipline, and the recent amazing discoveries by D. A. Goldston-J. Pintz-C. Y. Yildirim, Y. Zhang, J. Maynard, and T. Tao are typical instances. I shall quickly overview the relevant history of the distribution of primes, especially that of sieve methods. You will find all basic ideas are so simple that you will certainly be persuaded that the proverb “small things stir up great” is indeed a truth.

第V会場

竹 村 彰 通 (東大情報理工) 計算代数統計の最近の展開について ..... (13:00~14:00)

Akimichi Takemura (Univ. of Tokyo) On recent developments of computational algebraic statistics

概要 We discuss some recent developments of computational algebraic statistics. In particular we explain holonomic gradient method, which was recently introduced by the members of the JST CREST Hibi project team, and show how the method leads to fundamental reformulation of classical distribution theory of statistics.

## 第VII会場

清水 悟 (東北大理) 多変数複素解析における特殊領域 ..... (13:00~14:00)  
 Satoru Shimizu (Tohoku Univ.) Special domains in several complex variables

概要 The purpose of this talk is to discuss special domains in several complex variables. Special domains in  $\mathbf{C}^n$  are those domains which are called Reinhardt domains, tube domains, circular domains, Hartogs domains, and so on. These domains may be characterized as domains whose holomorphic automorphism groups contain canonical continuous subgroups. For example, a Reinhardt domain in  $\mathbf{C}^n$  admits an  $n$ -dimensional compact torus action, while a tube domain in  $\mathbf{C}^n$  admits an  $n$ -dimensional real vector group action. In this talk, we mainly take up Reinhardt domains and tube domains, and explain about their different aspects as well as the complementary relations between them.

3月17日(月)

## 第V会場

高島 克幸 (三菱電機) 楕円曲線暗号の進展 ..... (13:00~14:00)  
 Katsuyuki Takashima The evolution of elliptic curve cryptography  
 (Mitsubishi Electric Corp.)

概要 Elliptic curve cryptography was proposed independently by Koblitz and Miller around 1986. Since then, it has evolved into a powerful tool for new applications. In the early stage, it provided a more compact realization of public key cryptography than RSA. The need for its security evaluation and appropriate parameter generation has opened a fruitful research area in algorithmic number theory. Around 2000, a pairing operation on an elliptic curve began to be used for new cryptographic functionalities like ID-based encryption, attribute-based encryption, etc. This new trend further enriched the elliptic curve algorithm research. Very recently, isogenies between elliptic curves were incorporated in a quantum-resistant public key cryptosystem. In this talk, I will survey the evolution of elliptic curve cryptography in terms of three central one-way functions, i.e., scalar multiplication, pairing operation, and isogeny sequence computation.

## 第VII会場

塩谷 隆 (東北大理) 空間の集中・収束・消散 ..... (13:00~14:00)  
 Takashi Shioya (Tohoku Univ.) Concentration, convergence, and dissipation of spaces

概要 For a given sequence of compact Riemannian manifolds (or more generally metric measure spaces), we consider the following three situations.

- (1) The sequence converges to a one-point space.
- (2) The sequence dissipates, i.e., the manifolds in the sequence are decomposed into small pieces and all such pieces are going to be far apart each other.
- (3) The sequence converges to some nontrivial space.

We are mainly interested in the case where the dimension is divergent to infinity. For example, for the sequence of the  $n$ -spheres in a Euclidean space, parametrized by the dimension  $n = 1, 2, \dots$ , we observe (1) if the radius is smaller than the order of  $\sqrt{n}$ . We observe (3) if the radius is larger than the order of  $\sqrt{n}$ . If the radius has order of  $\sqrt{n}$ , then we observe (3) and the limit is an infinite-dimensional Hilbert space with a Gaussian measure in some sense. This is similar to the phase transition phenomenon in the statistical mechanics. In this talk, we explain Gromov's theory of metric measure geometry and discuss such phase transition phenomenon.



3月18日(火)

## 第V会場

竹井 義次 (京大数理研) 特異摂動の代数解析学概説 — 指数的に微小な項の厳密な取り扱いをめぐって — ..... (13:00~14:00)

Yoshitsugu Takei (Kyoto Univ.) A survey on algebraic analysis of singular perturbation theory — on the exact treatment of exponentially small terms —

**概要** Algebraic analysis of singular perturbation theory deals with singularly perturbed differential equations and their solutions obtained in a perturbative way. A typical example is a one-dimensional Schrödinger equation and its WKB solution. As is well-known, a WKB solution is a divergent solution. Such a divergent solution is traditionally handled by using Poincaré's theory of asymptotic expansions, but the treatment of exponentially small terms (e.g., Stokes phenomena) then becomes a very subtle problem. In our approach exponentially small terms can be treated in a neat and exact manner through the Borel resummation method. Roughly speaking, exponentially small terms are controlled by a graph called "a Stokes graph".

In this talk, mainly using some concrete examples, we explain an outline of the exact WKB analysis, that is, the analysis of WKB solutions of a one-dimensional Schrödinger equation. We also discuss its generalization to higher order equations. If time permits, some recent advances and future problems will be referred as well.

## 第VII会場

内山 充 (島根大総合理工) 行列関数の解析 — 作用素不等式, 多項式系, ガンマ関数 — .. (13:00~14:00)

Mitsuru Uchiyama (Shimane Univ.) Analysis of matrix functions — Operator inequalities, polynomials, Gamma function —

**概要** Let  $f(t)$  be a real continuous function defined on an open interval  $I$  of the real axis. Then  $f(X)$  is well-defined for any bounded selfadjoint operator (or Hermitian matrix)  $X$  whose spectrum is in  $I$ .  $f$  is called an operator monotone function and denoted by  $f \in \mathbf{P}(I)$  if the mapping  $X \mapsto f(X)$  preserves operator order.  $t^\lambda \in \mathbf{P}(0, \infty)$  for  $0 < \lambda \leq 1$ , but  $t^\lambda \notin \mathbf{P}(0, \infty)$  for  $\lambda > 1$ . The Löwner (Loewner) theorem is fundamental on the study of this area:

$f \in \mathbf{P}(I)$  if and only if  $f$  has a holomorphic extension to the upper half plane  $\Pi_+$  of  $\mathbf{C}$  which is a Pick function.

$g(t)$  is said to *majorize*  $h(t)$  if  $h \circ g^{-1}$  is operator monotone. This was named after the classical *majorization* between two sets of real numbers. We first establish Product Theorem and then extend the Furuta inequality. We last refer to the principal inverses of polynomials and one of the gamma function.

# 数 学 基 礎 論 お よ び 歴 史

3月15日(土) 第Ⅲ会場

9:30~11:30

- 1 増田 茂 (京大数理研) The Sturm–Liouville type problem in the modeling of the Schrödinger equations ..... 20  
 Shigeru Masuda (Kyoto Univ.) The Sturm–Liouville type problem in the modeling of the Schrödinger equations

**概要** We discuss the modeling of the Schrödinger equations or the quantum equations. The classical mechanics of model, which they put in, are: the wave motion from Huygens' principle of wave, atomic motion from Kepler's law and Kepler motion, eigenvalue problems from the perturbation problem on Kepler motion, collision and transport between electron and nucleus, and entropy and probability from the gas theories like Maxwell and Boltzmann, etc. We document especially that the Sturm–Liouville type problems in the modeling of the Schrödinger equations, for which Schrödinger 1926 refers to, and these Sturm–Liouville's works 1836–37 on the boundary value problems of heat diffusion are based on the same sort of boundary value problems in the Poisson's mathematical theory of heat 1835.

- 2 増田 茂 (京大数理研) The earlier toil and toil in proving on the describability of trigonometric series ..... 20  
 Shigeru Masuda (Kyoto Univ.) The earlier toil and toil in proving on the describability of trigonometric series

**概要** After Lagrange expressed the theory of propagation of sound 1759–61 by the trigonometric series, Fourier 1822 proposes the analytical theory of heat, including the trigonometric series without proving the convergence. Since then, many mathematicians, like Poisson 1823, Cauchy 1823, et al. try the proof problem on the describability of trigonometric series until the success by Carlson 1966 of  $L^2$  and by Hunt 1968 of  $L^p$ . At first, Dirichlet 1837 introduces especially Cauchy 1823 as the only challenging one, however, falls himself into a circular argument. Liouville 1836 introduces Poisson 1823 as the first study of this sort. Kummer 1860, in the mourning paper of Dirichlet, evaluates Dirichlet's work 1837 on this problem. We focus on the earlier triers, such as Lagrange, Fourier, Poisson, Cauchy, Dirichlet, Liouville, et al., of proving trials on the describability of trigonometric series.

- 3 中根美知代 20世紀初めのシュタルク効果の考察とハミルトン・ヤコビ理論の進展 ・ 20  
 Michiyo Nakane Examination of the Stark effect and development of the Hamilton–Jacobi theory in early 20th century

**概要** In early 20th century, Schwarzschild and Epstein applied the Hamilton–Jacobi theory to their examinations of the Stark effects. In this process they introduced new mathematical ideas: action-angle variables, an idea of degeneracy and so on. Their work illustrates that the Hamilton–Jacobi theory was not prepared for the quantum theory in the 19th century but was developed to be applicable to the quantum theory.

- 4 真 島 秀 行 (お茶の水女大理)<sup>b</sup> 「綴術算経」の附録の問題について ..... 30  
 Hideyuki Majima (Ochanomizu Univ.) On the problem in the appendix of the “Tetsujutsu-Sankei (Mathematical Treatise on the Technique of Linkage)”

概要 In the appendix of the “Tetsujutsu-Sankei (Mathematical Treatise on the Technique of Linkage)”, Nakane solves the following problem: to find the sides of a triangle that shall have the values  $n$ ,  $n+1$  and  $n+2$ , and such that the perpendicular upon the longest side from the opposite vertex shall be rational. Citing his solution in the book “A History of Japanese mathematics”, Mikami and Smith assert that “Whether or not he made the induction complete does not, however, appear.” We discuss on the induction employed by Seki, Takebe and Nakane.

- 5 田 中 昭 太 郎 \* ローラン展開 —コーシーの積分公式と和田寧の定理— ..... 20  
 Shotaro Tanaka Laurent expansion —Cauchy’s integral formulae and Y. Wada’s theorems—

概要 Example: rational function  $f(z) = (6z^2 - 2z + 1)/(z+1)(2z-1)^2 = 1/(z+1) + 1/(2z-1) + 1/(2z-1)^2$ .  
 In  $\{1/2 < |z| < 1\}$ , by the definition we have Laurent expansion:  $\Sigma_0 : n \rightarrow \infty$   
 $f(z) = \Sigma_0\{(-1)^n z^n\} + \Sigma_0(1/2^{n+1})(1/z^{n+1}) + \Sigma_0\{(n+1)/2^{n+2}\}(1/z^{n+2})$ , (A)  
 by Wada’s theorems, power series:  $\Sigma_1 : k = 1 \rightarrow \infty$

#### 14:15~17:00

- 6 関 隆 宏 (新潟大企画戦略本部) 結合則を持たない部分構造論理に対する Gentzen 流の形式化 II ..... 15  
 Takahiro Seki (Niigata Univ.) A Gentzen-style formulation for non-associative substructural logics II

概要 Associativity (of fusion) is regarded as one of the important structural rules. Recently, some studies on non-associative substructural logics have been developed. In this talk, we consider a Gentzen-style formulation for some non-associative substructural logics including distributive substructural logics and prove the cut elimination theorem by a proof-theoretic method.

- 7 佐々木 克 巳 (南山大情報理工) The exact **K4**-models in **S4** ..... 15  
 Katsumi Sasaki (Nanzan Univ.) The exact **K4**-models in **S4**

概要 In 2010, we list all the exact **S4**-models for **F**( $n$ ) in **S4**, where **F**( $n$ ) is the set of modal formulas with finite propositional variables  $p_1, \dots, p_m$  and with finite modal degree  $\leq n$ . However, considering the case that  $n = 0$ , we can easily observe that an exact model for **F**(0) in **S4** does not have to be reflexive (i. e. **S4**-model). For example if  $m = 1$ ,  $W = \{\alpha, \beta\}$ ,  $R = \emptyset$ , and  $P(p_1) = \{\alpha\}$ , then  $M = \langle W, R, P \rangle$  is an exact model for **F**(0) in **S4**, but it is not **S4**-model. Here, we give a method to list all the exact **K4**-models for **F**( $n$ ) in **S4**.

- 8 藤田 憲悦 (群馬大工) Intermediate lambda-terms between Church and Curry ..... 15  
 A. Schubert (Univ. of Warsaw)  
 Ken-etsu Fujita (Gunma Univ.) Intermediate lambda-terms between Church and Curry  
 Aleksy Schubert (Univ. of Warsaw)

概要 It is well known that the type-checking and type-inference problems are undecidable for 2nd-order lambda-calculus in the Curry style, although those for the Church style are decidable. We introduce three intermediate structures between the Church and Curry styles, and show that one intermediate structure called a style of hole application becomes decidable for the type-related problems. We extend this idea to the omega-order calculus F-omega, and then prove that the type-related problems become undecidable at third order. It turns out that the decidable result on the problems is to be tight at order 2.

- 9 倉橋 太志 (神戸大システム情報) Rosser 可証性述語による Henkin 文について ..... 15  
 Taishi Kurahashi (Kobe Univ.) On Henkin sentences based on Rosser provability predicates

概要 We investigate Henkin sentences based on Rosser provability predicates, that is, sentences asserting their own provability in the sense of Rosser. We give a necessary and sufficient condition that a sentence is a Rosser-type Henkin sentence, and prove that any Rosser sentence can be a Rosser-type Henkin sentence. Also we prove the existence of a Rosser provability predicate whose Henkin sentences are all provable or refutable.

- 10 黒田 覚 (群馬県立女大文) On minimal three-sort theories for PSPACE and EXPTIME ..... 20  
 Satoru Kuroda On minimal three-sort theories for PSPACE and EXPTIME  
 (Gunma Pref. Women's Univ.)

概要 We construct three-sort theories of bounded arithmetic which captures PSPACE and EXPTIME. Our theories are minimal in the sense that they are contained in other theories capturing the corresponding classes. The idea for constructing such theories is succinctly represented versions of combinatorial problems.

- 11 横山 啓太 (北陸先端大情報) Finite iterations of infinite and finite Ramsey's theorem ..... 20  
 Keita Yokoyama (JAIST) Finite iterations of infinite and finite Ramsey's theorem

概要 In this talk, we study a slightly strengthened version of infinite Ramsey's theorem, which has a better correspondence to the Paris-Harrington principle and its finite iteration.

- 12 木原 貴行 (北陸先端大情報) ランダム性の保存と null-additivity ..... 15  
 宮部 賢志 (東大情報理工)  
 Takayuki Kihara (JAIST) Algorithmic randomness and null-additivity  
 Kenshi Miyabe (Univ. of Tokyo)

概要 We say that a set  $A$  of natural numbers preserves  $\mathcal{R}$ -randomness if for every  $\mathcal{R}$ -random set  $B \subseteq \mathbb{N}$ , the symmetric difference  $A \triangle B$  of  $A$  and  $B$  is again  $\mathcal{R}$ -random, where  $\mathcal{R}$  is an arbitrary randomness notion. By using characterizations of null-additivity in the set theory of the real line, we determine the condition fulfilling  $\mathcal{R}$ -randomness preservation for several randomness notions  $\mathcal{R}$ .

- 13 宮 部 賢 志 (東大情報理工・JSPS) 積分テストに対する Lebesgue 点の特徴付け ..... 20  
 Kenshi Miyabe (Univ. of Tokyo/JSPS) Characterization of being a Lebesgue point for integral tests

概要 The effectivization of almost-everywhere-type theorems usually give randomness notions. Some randomness notions have been characterized via differentiability, via the Lebesgue density theorem and via the Lebesgue differentiation theorem. In this talk, I will give some recent development on this topic. In particular, a new randomness notion of density randomness is characterized via the differentiation theorem for integral tests. Furthermore, I will discuss why the definition of density randomness requires ML-randomness explicitly.

- 14 河 村 彰 星 (東大情報理工) 縮小写像による距離三等分線の構成 ..... 15  
 Akitoshi Kawamura (Univ. of Tokyo) Distance trisector curves via the contraction mapping theorem

概要 The (distance) trisector between two points  $p$  and  $q$  in the Euclidean plane is the pair of curves  $A$  and  $B$  such that  $A$  is the set of points equidistant from  $p$  and  $B$ , and  $B$  is the set of points equidistant from  $q$  and  $A$ . Such a pair of curves exists, is unique, and can be computed in polynomial time in a certain sense, as was shown by Asano, Tokuyama and Matoušek in 2006. A somewhat simpler and more general existence and uniqueness proofs based on the Tarski fixed point theorem were given later by Imai et al. and Kawamura, Tokuyama and Matoušek. We give yet another, short proof of these facts (in the original special setting) by showing that the trisector is the fixed point of a contraction mapping in a certain metric space.

## 3月16日(日) 第Ⅲ会場

9:30~11:40

- 15 大 藪 卓 数学と熱力学, 他 17 件 ..... 5  
 Takashi Oyabu Mathematics an thermodynamics, and other 17 talks

概要 1. Algebraic function and Riemann surface:

2.  $O(n) = G$ : homotopy equivalent  $\implies O(n) = G$ : isomorphic: homeomorphic:

3.  $C^\infty(G) = \oplus \Sigma H_i$ :  $L_2(G) = \oplus \Sigma V_i$ : representation of  $Diff(M) :: Aut(R)$ :

4. Differential equations in thermodynamics and mathematics:

5. General  $H$ : -theorems: introduction of entropy in mathematics:

6.  $J : X(1) \implies S \cup C\{\infty\} \implies C \implies C/L = E : K(V) \sum_0(N) = K(V)$ :

7.  $C^\infty(M) = C^\infty(M')$ : homotopy equivalent  $\implies C^\infty(M) = C^\infty(M')$ : linearly equivalent:

8.  $G$ : compact real Lie group:  $G = G'$ : homotopy equivalent  $\implies G = G'$ : isomorphic: homeomorphic:

9. Entropy:  $H$ -theorem: and of parabolic type:

10. Inconsistency of the axioms of group and algebras: some considerations:

11.  $O(n) = G$ : homotopy equivalent  $\implies O(n)G$ : isomorphic: homeomorphic:

12.  $G = G'$ : compact: real Lie groups: homotopy equivalent  $\implies G = G'$ : isomorphic: homeomorphic:

13.  $J : X(1) \implies S = C \cup \{\infty\} \implies C \implies C/L = E : K(V) \sum_0(N) = K(V)$

14. Entropy in mathematics is introduced: and  $H$ -theorems: of parabolic type:  $dH/dt = < 0 \implies 0$ :

15. Differential equations in thermodynamics and mathematics:

16. Entropy in mathematics is introduced:  $H$ -theorems: of parabolic type:  $dH/dt = < 0 \implies 0$ :

17. Differential equations in thermodynamics and mathematics:

18. Entropy in mathematics is introduced:  $H$ -theorems: of parabolic type:  $dH/dt = < 0 \implies 0$ :

- 16 池田宏一郎 (法政大経営) モデル完全なジェネリック構造 I ..... 15  
 桔梗宏孝 (神戸大システム情報)  
 Koichiro Ikeda (Hosei Univ.) Model complete generic structures I  
 Hirotaka Kikyo (Kobe Univ.)

概要 In 1988, Hrushovski constructed new strongly minimal generic structure to give a counterexample to the Zilber conjecture. In his paper, Hrushovski pointed out that the theory of his structure is nearly model complete. In this talk, we give a characterization of model completeness in generic structures. Using the characterization, we want to consider model completeness of Hrushovski's strongly minimal structure.

- 17 桔梗宏孝 (神戸大システム情報) モデル完全なジェネリック構造 II ..... 15  
 池田宏一郎 (法政大経営)  
 Hirotaka Kikyo (Kobe Univ.) Model complete generic structures II  
 Koichiro Ikeda (Hosei Univ.)

概要 We consider hyper-graphs with 3-hyper-edges. Let  $A$  be such a hyper-graph. Let  $\delta(A) = |A| - e(A)$  where  $e(A)$  is the number of hyper-edges in  $A$ . Suppose  $A$  is a hyper-subgraph of  $C$ . If  $A \subsetneq X \subset C$  implies  $\delta(A) < \delta(X)$ , then we write  $A < C$ . Let  $f(x) = \log_3(x+1)$ . Let  $K_f = \{A \mid B \subset A \Rightarrow \delta(B) \geq f(|B|)\}$ . Then the theory of the generic structure of  $(K_f, <)$  is model complete. More generally, if  $f$  is a concave function almost satisfying  $f^{-1}(x+1) \geq 3f^{-1}(x)$  with certain conditions then we get the same result.

- 18 小澤 正直 (名大情報) Maximal beable subuniverse of quantum set theory ..... 30  
Masanao Ozawa (Nagoya Univ.) Maximal beable subuniverse of quantum set theory

**概要** According to the Kochen–Specker theorem some statements on a quantum system are not speakable in the sense that they cannot be assigned truth values. In order to solve a fundamental problem as to what are speakable about quantum reality, here, it is proved that there exists a unique subuniverse of the Takeuti universe of quantum set theory such that it satisfies every theorem of ZFC set theory in a given state, it contains a given observable, and that it is invariant under all automorphisms that preserve the given state and the given observable. It is also proved that the real numbers in this maximal subuniverse coincides with the maximal beable subalgebra previously determined by Halvorson and Clifton.

- 19 依岡 輝幸 (静岡大理) Side condition method を用いた forcings の新しい保存定理 ..... 15  
Teruyuki Yorioka (Shizuoka Univ.) New preservation theorems for forcings with models as side conditions

**概要** It is proved that if it is consistent that there exists a supercompact cardinal, then it is consistent that there are no  $S$ -spaces, the  $P$ -ideal dichotomy holds, and the pseudo-intersection number is equal to  $\aleph_1$ . This answers the question due to Stevo Todorćević.

- 20 瀧野 昌 (神戸大システム情報) Rado's conjecture and reflection principles compatible with MM ..... 40  
Sakaé Fuchino (Kobe Univ.) Rado's conjecture and reflection principles compatible with MM

**概要** We propose a new reflection principle, a variant of strong Chang's Conjecture, which is strong enough to deduce all known common consequences of Rado's Conjecture and  $MA^+(\sigma\text{-closed})$  including FRP and SSR.

### 13:10~14:10 特別講演

- 平田 康史 (神奈川大工) 順序数, LOTS, 単調正規空間とその積の位相的性質の比較  
Yasushi Hirata (Kanagawa Univ.) Comparing some topological properties of ordinals, LOTS', monotonically normal spaces, and their products

**概要** It is well-known that every GO-space (=generalized ordered space) and every metrizable space are orthocompact and monotonically normal. And subspaces of ordinals are typical examples of GO-spaces. In this talk, we compare topological properties among subspaces of ordinals, GO-spaces, and monotonically normal spaces and their products. For instance, Kemoto and Smith proved that  $A \times B$  is countably metacompact for every subspaces  $A$  and  $B$  of ordinals. On the other hand, I and Kemoto found an example of a LOTS (=linearly ordered space)  $L_\kappa$  for each regular uncountable cardinal  $\kappa$  such that  $\kappa \times L_\kappa$  is not countably metacompact. For a monotonically normal space  $X$  and a subspace  $B$  of an ordinal, I, Kemoto and Yajima characterized orthocompactness of  $X \times B$  and normality with rectangularity of  $X \times B$  by observing neighborhood properties of spaces and closed sets which are homeomorphic to stationary sets. We will talk about these results.

## 代 数 学

3月15日(土) 第I会場

9:00~12:00

- 1 飯 高 茂 (学 習 院 大\*) オイラー関数の変種について ..... 10  
Shigeru Iitaka (Gakushuin Univ.\*) A variation of Euler's phi-function

概要 Euler's phi-function of the second kind (denoted by  $\varphi_1(a)$ ) and associated Euler's phi-function (denoted by  $\tilde{\varphi}(a)$ ) shall be introduced.

Actually,  $\tilde{\varphi}(a)$  is defined to be  $\varphi(a)/2^s$ ,  $s$  being the number of distinct prime factors of  $a$ . Further,  $\varphi_1(a)$  coincides with  $\tilde{\varphi}(a)a$ . It seems true that  $\tilde{\varphi}(a)$  has properties which are easily treated then the original  $\varphi(a)$ .

- 2 岩 見 智 宏 (九 州 産 大 工)\* 半安定型の (三次元) 志村多様体に対する射影性判定条件について ..... 10  
Tomohiro Iwami On a projectivity criterion for certain three-dimensional Shimura varieties of semi-stable type  
(Kyushu Sangyo Univ.)

概要 Yujiro Kawamata already showed at around 1992 that there exist semi-stable minimal models of threefolds over positive and mixed characteristic in terms of characteristic-free arguments by Shuichiro Tsunoda and Masayoshi Miyanishi around 1980's. Recently János Kollár et al showed that the contractibility of dual complexes, including similar result of Thuillier by using Berkovich spaces. In this talks, the author will consider a projectivity criterion for certain three-dimensional Shimura varieties of semi-stable singularities in the sense of J. Kollár and Shigefumi Mori, based on the quotient space by groupoids in the sense of S. Keel and S. Mori, with regards to these previous works.

- 3 安 藤 哲 哉 (千 葉 大 理) 3変数斉次巡回不等式についての進展 ..... 15  
Tetsuya Ando (Chiba Univ.) Development on cyclic homogeneous polynomial inequalities of three variables

概要 The set of all the cyclic homogeneous polynomial inequalities of real three variables of degree  $d$  form a closed convex cone. We observe the structure of such cones for  $d = 3, 4, 5$  and  $6$ . Especially, we determine the algebraic structure of the boundaries of such cones. As corollary, we present some conditions to determine whether given inequality holds or not.

- 4 土 基 善 文 (高 知 大 理) 有限体上の力学系と非可換幾何学 ..... 15  
Yoshifumi Tsuchimoto (Kochi Univ.) Dynamical system over a finite field and non commutative algebraic geometry

概要 We consider dynamical systems over finite fields. Structure of maximal ideals of a crossed product  $A$  is discussed. Hasse zeta function of the category of  $A$ -modules is discussed.



- 5 岡田 崇 (小山工高専) Quintic periods and stability conditions via homological mirror symmetry ..... 10  
 So Okada (Oyama Nat. Coll. of Tech.) Quintic periods and stability conditions via homological mirror symmetry

概要 On the Fermat quintic Calabi–Yau threefold and the theory of stability conditions due to Bridgeland and Douglas, we affirmatively answer physically motivated mathematical aims due to Hosono, Kontsevich, Thomas–Yau, and Walcher. Our method is based on homological mirror symmetry and stability conditions of Bridgeland type, which we introduce with their spaces. As a consequence, we obtain a quasimodular form attached to periods of the mirror family of the quintic by motivic Donaldson–Thomas invariants. The original motivation to attach quasimodular forms to these periods goes back to Dijkgraaf.

- 6 桜井 真 カイラル代数とヒッグス束安定条件の代数化 ..... 15  
 Makoto Sakurai Chiral algebras and algebraization of Higgs bundles’ stability

概要 Several notions of stability conditions including the Deligne–Mumford compactification of smooth projective curves are being discussed in different contexts. In this talk, I will report my algebraic framework that will incorporate the BPS stability condition of Hitchin’s stable Higgs bundles in addition to the chiral scalar fields of quantum field theory inspired by the Higgs mechanism of theoretical physicists and its algebraic geometry. I will especially try to build a “quasi-projective” algebraic geometry which includes, but is not limited to, the parabolic geometry of the well-known parabolic geometry. The examples include the blowups of the complex projective plane, which seem to be the underlying geometry of recent developments by theoretical particle physicists.

- 7 王 楠 (埼玉大理工) Hyperelliptic and trigonal curves among cyclic coverings of the projective line ..... 15  
 酒井 文雄 (埼玉大理工) .....  
 Nan Wang (Saitama Univ.) Hyperelliptic and trigonal curves among cyclic coverings of the projective line  
 Fumio Sakai (Saitama Univ.)

概要 Let  $V$  be a  $d$ -cyclic covering of the complex projective line with  $n$  branch points. We give necessary and sufficient for (1) whether  $V$  is hyperelliptic for arbitrary  $n$  and  $d$ ; (2) whether  $V$  is trigonal for  $n = 3$  and arbitrary  $d$ ; (3) whether  $V$  is trigonal for  $n \geq 4$  and prime  $d$ .

- 8 松田 修 (津山工高専) Classification of curves on irrational ruled surfaces by mixed plurigenera ..... 15  
 Osamu Matsuda Classification of curves on irrational ruled surfaces by mixed plurigenera  
 (Tsuyama Nat. Coll. of Tech.)

概要 Let  $S$  be a non-singular irrational surface with positive irregularity  $q$  and  $D$  an non-singular curve on  $S$ . If any exceptional curve  $E$  (of first kind) on  $S$  satisfies  $E \cdot D \geq 2$  ( $E \neq D$ ), then a pair  $(S, D)$  is said to be relative minimal. Suppose that  $m \geq a \geq 1$ . Then  $P_{m,a}[D] = \dim[mK + aD] + 1$  are called mixed plurigenera, where  $K$  indicates a canonical divisor on  $S$ . We shall give a classification of relative minimal pairs  $(S, D)$  by  $P_{m,a}[D]$ .

- 9 渡 邊 健 太 (阪 大 理)\*  $\mathbb{P}^3$  の 4 次超曲面における ACM 直線束の分類について ..... 10  
 Kenta Watanabe (Osaka Univ.) On the classification of ACM line bundles on quartic hyper surfaces of  $\mathbb{P}^3$

概要 We work over the complex number field  $\mathbb{C}$ . Let  $X$  be a smooth hyper surface of  $\mathbb{P}^n$  and  $\mathcal{O}_X(1)$  be the very ample line bundle given by a hyper plane section of  $X$ . Then, a vector bundle  $\mathcal{E}$  on  $X$  is called *Arithmetically Cohen–Macaulay* (ACM for short) if the cohomology groups  $H^i(X, \mathcal{E}(l))$  for  $1 \leq i \leq \dim(X) - 1$  and  $l \in \mathbb{Z}$  vanish, where  $\mathcal{E}(l) := \mathcal{E} \otimes \mathcal{O}_X(l)$ .

In this talk, we give a complete classification of initialized and ACM line bundles on a smooth quartic hyper surface on  $\mathbb{P}^3$ .

- 10 向 井 茂 (京大数理研) 4 次対称  $K3$  曲面から決まるエンリケス曲面の自己同型群の決定 ..... 15  
 大 橋 久 範 (東京理大理工)  
 Shigeru Mukai (Kyoto Univ.) The automorphism groups of Enriques surfaces covered by symmetric  
 Hisanori Ohashi (Tokyo Univ. of Sci.) quartic surfaces

概要 We compute the full automorphism group of the Enriques surface  $S$  covered by some explicitly defined symmetric quartic  $K3$  surface  $X$ . We give both the presentation and the realization of  $\text{Aut}(S)$ . At the same time, we classify curves of genus 0 and 1 on  $S$  up to automorphisms.

- 11 内 海 和 樹 (広島大理) Jacobian fibrations on the singular  $K3$  surface of discriminant 3 ..... 10  
 Kazuki Utsumi (Hiroshima Univ.) Jacobian fibrations on the singular  $K3$  surface of discriminant 3

概要 We give the Weierstrass equations and the generators of Mordell–Weil groups for Jacobian fibrations on the singular  $K3$  surface of discriminant 3.

- 12 古 川 勝 久 (早大基幹理工) On general fibers of Gauss maps in arbitrary characteristic ..... 15  
 Katsuhisa Furukawa (Waseda Univ.) On general fibers of Gauss maps in arbitrary characteristic

概要 We investigate general fibers of the Gauss map  $\gamma$  of a projective variety  $X$  in  $\mathbb{P}^N$ , in terms of the degeneracy map  $\kappa$  from  $X$  to a Grassmann variety. As a result of our previous work, if  $\gamma$  is separable, then a general fiber of  $\gamma$  coincides with the linear subvariety  $\kappa(x)$  of  $\mathbb{P}^N$  for general  $x$  in the fiber. In this talk, we explain: (1) Equivalence of the separability of the two maps  $\gamma$  and  $\kappa$ . (2)  $\kappa(x)$  is constant on  $x \in F$  for each irreducible component  $F$  of a general fiber of  $\gamma$ ; in particular,  $F$  is contained in this constant linear subvariety even if  $\gamma$  is inseparable. (3) The inseparability of Gauss maps of strange varieties.

## 14:15~16:30

- 13 渡辺 究 (埼玉大理工)\* Characterization of the complete flag manifold of type  $F_4$  ..... 15  
 Kiwamu Watanabe (Saitama Univ.) Characterization of the complete flag manifold of type  $F_4$

概要 Let  $X$  be a Fano manifold whose elementary contractions are smooth  $\mathbb{P}^1$ -fibrations, which is not a product. In the previous meeting of MSJ, I explained how to construct a simple Lie group associated to  $X$ , and  $X$  is homogeneous, provided that  $G$  is not of type  $F_4$ . In my talk, under the additional assumption that the tangent bundle of  $X$  is nef, I shall show that the same holds for the case of type  $F_4$ . Furthermore, I will explain the relation between the result and the Campana–Peternell Conjecture on Fano manifolds with nef tangent bundles. This is a joint work with G. Occhetta, L. E. Solá Conde and J. Wiśniewski.

- 14 高橋 正 (甲南大知能情報) 消去イデアルの応用 V ..... 10  
 Tadashi Takahashi (Konan Univ.) On the application of elimination ideal V

概要 We consider the normal forms and the restrictions of singular plane quartic curves in the two dimensional complex projective space. Then we can get the restrictions by using the Groebner basis of the elimination ideal, we show the restrictions of singular plane quartics.

- 15 中嶋 祐介 (名大多元数理) 有理2重点における Cohen–Macaulay 加群の dual  $F$ -signature について ..... 15  
 Yusuke Nakajima (Nagoya Univ.) Dual  $F$ -signature of Cohen–Macaulay modules over rational double points

概要 The notion of  $F$ -signature is defined by Huneke and Leuschke. It is known that the  $F$ -signature characterizes some singularities. This notion is extended to finitely generated modules and called dual  $F$ -signature. In this talk, we determine the dual  $F$ -signature of Cohen–Macaulay modules over two-dimensional rational double points.

- 16 後藤 四郎 (明大理工) Huneke–Wiegand conjecture and change of rings ..... 15  
 高橋 亮 (名大多元数理)  
 谷口 直樹 (明大理工)  
 Hoang Le Truong (IMVAST)  
 Shiro Goto (Meiji Univ.) Huneke–Wiegand conjecture and change of rings  
 Ryo Takahashi (Nagoya Univ.)  
 Naoki Taniguchi (Meiji Univ.)  
 Hoang Le Truong (IMVAST)

概要 Let  $R$  be a Cohen–Macaulay local ring of dimension one with a canonical module  $K_R$ . Let  $I$  be a faithful ideal of  $R$ . We explore the problem of when  $I \otimes_R I^\vee$  is torsionfree, where  $I^\vee = \text{Hom}_R(I, K_R)$ . We prove that if  $R$  has multiplicity at most 6, then  $I$  is isomorphic to  $R$  or  $K_R$  as an  $R$ -module, once  $I \otimes_R I^\vee$  is torsionfree. This result is applied to monomial ideals of numerical semigroup rings. A higher dimensional assertion is also discussed.

- 17 後藤 四郎 (明大理工)\* 巴系イデアルの第1オイラー標数とホモロジカル次数について ..... 15  
大関 一秀 (山口大理工)

Shiro Goto (Meiji Univ.) The first Euler characteristics versus the homological degrees  
Kazuho Ozeki (Yamaguchi Univ.)

概要 The notion of homological degree was introduced by W. V. Vasconcelos and his students in 1998, and since then, many authors have been engaged in the development of the theory. Recently, Ghezzi, Hong, Phuong, Vasconcelos, and the authors also make use of homological degrees to obtain bounds for the Hilbert coefficients of parameters. The purpose of this talk is to study the relationship between the first Euler characteristics and the homological degrees of modules.

- 18 後藤 四郎 (明大理工)\* 巴系イデアルの第1ヒルベルト係数とホモロジカルトーションについて  
大関 一秀 (山口大理工) ..... 10

Shiro Goto (Meiji Univ.) Relation between the first Hilbert coefficients and the homological tor-  
Kazuho Ozeki (Yamaguchi Univ.) sions

概要 We study homological torsions of modules and give a criterion for a certain equality of the first Hilbert coefficients of parameters and the homological torsions of modules.

- 19 飯間 圭一郎 (奈良工高専)\* Linkage of modules over a Gorenstein local ring ..... 15  
高橋 亮 (名大多元数理)

Kei-ichiro Iima Linkage of modules over a Gorenstein local ring  
(Nara Nat. Coll. of Tech.)  
Ryo Takahashi (Nagoya Univ.)

概要 The notion of linkage of modules was first studied by Yoshino and Isogawa. Later on it was explored by Martsinkovsky, Strooker and Nagel. Recently it has been investigated by many authors. In this talk, we aim at reconsidering a theorem of Yoshino and Isogawa by introducing the notion of linkage with respect to a perfect module.

- 20 荒谷 督司 (岡山理大理) Thick subcategories of stable categories over graded Gorenstein rings  
..... 10

Tokuji Araya (Okayama Univ. of Sci.) Thick subcategories of stable categories over graded Gorenstein rings

概要 R. Takahashi classified the thick subcategories of the stable category of maximal Cohen–Macaulay modules over a hypersurface local ring. By his classification, we can see that if the base ring has an isolated singularity, then the thick subcategories are trivial. On the other hand, if the base ring is graded, then there exist non-trivial thick subcategories. In this talk, we will classify the thick subcategories of the stable category of graded maximal Cohen–Macaulay modules over a graded Gorenstein rings of finite Cohen–Macaulay representation type.

- 21 黒田 茂 (首都大東京理工) The automorphism group of an integral domain over the kernel of a locally nilpotent derivation ..... 15  
 Shigeru Kuroda (Tokyo Metro. Univ.) The automorphism group of an integral domain over the kernel of a locally nilpotent derivation

**概要** For a  $\mathbf{Q}$ -domain  $A$  and a nonzero locally nilpotent derivation  $\delta$  of  $A$ , we consider the automorphism group  $\text{Aut}(A/A^\delta)$  of the  $A^\delta$ -algebra  $A$ , where  $A^\delta := \{a \in A \mid \delta(a) = 0\}$ . Let  $N_\delta$  be the set of the exponential automorphisms for the locally nilpotent  $A^\delta$ -derivations of  $A$ . Then,  $N_\delta$  is a normal subgroup of  $\text{Aut}(A/A^\delta)$ . In this talk, we discuss the structure of the quotient group  $\text{Aut}(A/A^\delta)/N_\delta$ . Our main result implies that, if  $A$  is a UFD such that  $A^\times \cup \{0\}$  is a field, then  $\text{Aut}(A/A^\delta)/N_\delta$  is isomorphic to  $A^\times$  or a finite cyclic subgroup of  $A^\times$ .

#### 16:45~17:45 特別講演

- 安田 健彦 (阪大 理) 野生 McKay 対応の展望  
 Takehiko Yasuda (Osaka Univ.) Perspectives on the wild McKay correspondence

**概要** I will talk about my recent works (partly joint with Melanie Wood) on the McKay correspondence in the wild situation, and also about possible applications and future problems.

In the late 90's, Batyrev formulated the McKay correspondence in arbitrary dimension in characteristic zero by using stringy invariants, and proved it. Later Denef and Loeser gave an alternative and more conceptual proof using the motivic integration. A few years ago, I started to generalize their works to positive characteristics, in order to understand wild quotient singularities, that is, quotient singularities such that the relevant finite group has order divisible by the characteristic of the base field. It has turned out that although there is a significant difference, the basic strategy of Denef and Loeser is valid in positive characteristic too. Because of some technical difficulties, the final statement is still a conjecture. However, if it is true, it would relate singularities and the number theory. In the talk, I will also mention possible applications to desingularization problems, and also future problems including the globalization problem and explicit computations.

### 3月16日(日) 第I会場

#### 9:00~12:00

- 22 川崎 謙一郎 (奈良教育大教育) 正則環上の複体が余有限になるためのある特徴付けについて ..... 10  
 Ken-ichiroh Kawasaki On a characterization of cofinite complexes over regular rings of finite  
 (Nara Univ. of Edu.) dimension

**概要** We introduce a result on a question when the bounded-below complexes are  $J$ -cofinite, where  $J$  is an ideal of a regular ring of finite dimension.

- 23 上岡修平 (京大情報) Laurent biorthogonal polynomials,  $q$ -Narayana polynomials and domino tilings of the Aztec diamonds ..... 15  
 Shuhei Kamioka (Kyoto Univ.) Laurent biorthogonal polynomials,  $q$ -Narayana polynomials and domino tilings of the Aztec diamonds

概要 A Toeplitz determinant whose entries are described by a  $q$ -analogue of the Narayana polynomials is evaluated by means of Laurent biorthogonal polynomials which allow of a combinatorial interpretation in terms of Schröder paths. As an application, a new proof is given to the Aztec diamond theorem by Elkies, Kuperberg, Larsen and Propp concerning domino tilings of the Aztec diamonds. The proof is based on the correspondence with non-intersecting Schröder paths developed by Johansson.

- 24 日比孝之 \* 有限グラフに付随する edge ring が強 Koszul となるための必要十分条件  
 (阪大情報・JST CREST) ..... 15  
 松田一徳  
 (立教大理・JST CREST)  
 大杉英史  
 (立教大理・JST CREST)  
 Takayuki Hibi A necessary and sufficient condition for strong Koszulness of edge rings  
 (Osaka Univ./JST CREST) associated with finite graphs  
 Kazunori Matsuda  
 (Rikkyo Univ./JST CREST)  
 Hidefumi Ohsugi  
 (Rikkyo Univ./JST CREST)

概要 We classify the finite connected simple graphs whose edge rings are strongly Koszul. It then follows that if the edge ring is strongly Koszul, then its toric ideal possesses a quadratic Gröbner basis.

- 25 日比孝之 Cameron-Walker グラフの可換環論的性質 ..... 15  
 (阪大情報・JST CREST)  
 東谷章弘 (阪大情報)  
 木村杏子 (静岡大理)  
 A. B. O'Keefe (Univ. of Kentucky)  
 Takayuki Hibi Algebraic study on Cameron-Walker graphs  
 (Osaka Univ./JST CREST)  
 Akihiro Higashitani (Osaka Univ.)  
 Kyouko Kimura (Shizuoka Univ.)  
 Augustine B. O'Keefe  
 (Univ. of Kentucky)

概要 In this talk, we define Cameron-Walker graphs and discuss some algebraic properties on edge ideals of Cameron-Walker graphs.

- 26 東谷章弘 (阪大情報) 辺凸多面体のミンコフスキー和とその正規性 ..... 15  
 Akihiro Higashitani (Osaka Univ.) Minkowski sum of edge polytopes and its normality

概要 In this talk, we discuss the normality or the integer decomposition property of Minkowski sum of edge polytopes.

- 27 亀山 統胤 (信州大総合工) Categories including all G-projective modules ..... 10  
 木村 祐子 (信州大工)  
 西田 憲司 (信州大理)  
 Noritsugu Kameyama (Shinshu Univ.) Categories including all G-projective modules  
 Yuko Kimura (Shinshu Univ.)  
 Kenji Nishida (Shinshu Univ.)

概要 We generalize the some results of Ryo Takahashi to the categories of modules over noncommutative noetherian rings. Let the subcategories  $\mathcal{A}_k, \mathcal{B}_k$  ( $k \geq 1$ ) of  $\text{mod}\Lambda$  be  $\mathcal{A}_k = \{M \in \text{mod}\Lambda \mid \text{Ext}_\Lambda^i(\text{Tr}M, \Lambda) = 0, 1 \leq i \leq k\}$  and  $\mathcal{B}_k = \{N \in \text{mod}\Lambda \mid \text{Ext}_\Lambda^i(N, \Lambda) = 0, 1 \leq i \leq k\}$ . Let  $\mathcal{G}$  be the category of all G-projective modules. Then we study what properties of  $\mathcal{G}$  are succeeded to  $\mathcal{A}_k \cap \mathcal{B}_k$ . We also study the category equivalence between  $\mathcal{A}_k$  and  $\mathcal{B}_k$ .

- 28 足立 崇英 (名大多元数理) Classifying two-term tilting complexes for Brauer graph algebras ..... 15  
 相原 琢磨 (名大多元数理)  
 A. Chan (Univ. of Aberdeen)  
 Takahide Adachi (Nagoya Univ.) Classifying two-term tilting complexes for Brauer graph algebras  
 Takuma Aihara (Nagoya Univ.)  
 Aaron Chan (Univ. of Aberdeen)

概要 In this talk, we study two-term tilting complexes for Brauer graph algebras which are special biserial algebras defined by graphs. We classify two-term pretilting complexes by the special notion of walk, called admissible weighted line, on a graph. One of the main result we obtained is a bijection between the set of indecomposable two-term pretilting complexes and the set of admissible weighted lines. Furthermore, we use this bijection to obtain a combinatorial description for two-term tilting complexes. As an application, we can easily calculate the graph of the endomorphism ring of a two-term tilting complexes.

- 29 足立 崇英 (名大多元数理) Tilting-connectedness of Brauer graph algebras ..... 15  
 相原 琢磨 (名大多元数理)  
 A. Chan (Univ. of Aberdeen)  
 Takahide Adachi (Nagoya Univ.) Tilting-connectedness of Brauer graph algebras  
 Takuma Aihara (Nagoya Univ.)  
 Aaron Chan (Univ. of Aberdeen)

概要 In this talk, we study a combinatorial structure of the class of tilting complexes for Brauer graph algebras, which is a representation-tame symmetric algebra. The class of tilting complexes possess a partial ordering. Then the following question arises naturally: When is the corresponding Hasse quiver connected? Our aim of this talk is to give a partial answer to the question. Brauer graph algebras are defined by graphs. A graph is said to be of type odd if it is a tree, or has only one subcycle of odd length and none of even length. We show that, if the graph of a Brauer graph algebra is of type odd, then the corresponding Hasse quiver is connected.

- 30 長 瀬 潤 (東京学大教育)\* Dynkin クイバーに付随する正則概均質ベクトル空間の数え上げ ..... 10  
 名 倉 誠 (奈良工高専)  
 Hiroshi Nagase (Tokyo Gakugei Univ.) Counting regular prehomogeneous vector spaces associated with Dynkin  
 Makoto Nagura quivers  
 (Nara Nat. Coll. of Tech.)

概要 We count the number of isomorphism classes of hom-orthogonal partial tilting modules over path algebras of Dynkin quiver of type  $\mathbb{A}_n$ ,  $\mathbb{D}_n$ , or  $\mathbb{E}_n$ . This number is independent on the choice of an orientation of the arrows, and the number for  $\mathbb{A}_n$  or  $\mathbb{D}_n$ -type can be expressed as a special value of a hypergeometric function. As a consequence of our theorem, we obtain a minimum value of the number of basic relative invariants of corresponding regular prehomogeneous vector spaces.

- 31 浅 芝 秀 人 (静岡大理) Tilted algebras and configurations of self-injective algebras of Dynkin  
 中 島 健 (静岡大理) type ..... 10  
 Hideto Asashiba (Shizuoka Univ.) Tilted algebras and configurations of self-injective algebras of Dynkin  
 Ken Nakashima (Shizuoka Univ.) type

概要 All algebras are assumed to be basic, connected finite-dimensional algebras over an algebraically closed field. We give a direct formula for a bijection from the set of isoclasses of tilted algebras of Dynkin type  $\Delta$  to the set of configurations on the translation quiver  $\mathbb{Z}\Delta$ .

- 32 清 水 健 一 (名大多元数理) A characterization of unimodular finite tensor categories ..... 15  
 Kenichi Shimizu (Nagoya Univ.) A characterization of unimodular finite tensor categories

概要 The notion of unimodular finite tensor categories, introduced by Etingof, Nikshych and Ostrik, is a categorical generalization of the notion of finite-dimensional unimodular Hopf algebras. In this talk, I give a new characterization for unimodularity: A finite tensor category  $\mathcal{C}$  is unimodular if and only if the forgetful functor from  $\mathcal{Z}(\mathcal{C}) \rightarrow \mathcal{C}$ , where  $\mathcal{Z}(\mathcal{C})$  is the monoidal center of  $\mathcal{C}$ , is a Frobenius functor. This result is a categorical generalization of a theorem due to Caenepeel, Militaru and Zhu. I also give a generalization of the construction of commutative Frobenius algebra in a braided monoidal category due to Ishii and Masuoka.

### 13:15~14:15 特別講演

- 池 田 岳 (岡山理大理) 古典型旗多様体の K 理論  
 Takeshi Ikeda (Okayama Univ. of Sci.) K-theory of the flag varieties of classical type

概要 We introduce a family of polynomials that is identified with the basis consisting of the structure sheaves of the Schubert varieties in the torus equivariant K-theory of the flag variety of the classical types. We also review the corresponding results for the equivariant cohomology.



## 3月17日(月) 第I会場

## 9:30~12:00

- 33 神田 遼 (名大多元数理)<sup>b</sup> Specialization orders on atom spectra of Grothendieck categories ..... 15  
 Ryo Kanda (Nagoya Univ.) Specialization orders on atom spectra of Grothendieck categories

概要 The notion of the atom spectra of Grothendieck categories is a generalization of the prime spectra of commutative rings. We develop a theory of the specialization orders on the atom spectra of Grothendieck categories and introduce systematic methods to construct Grothendieck categories from colored quivers. We show that any partially ordered set is realized as the atom spectrum of some Grothendieck category, which is an analog of Hochster's result in commutative ring theory.

- 34 板垣 智洋 (東京理大理) The dimension formula of the cyclic homology of truncated quiver algebras over a field of positive characteristic ..... 10  
 眞田 克典 (東京理大理)  
 Tomohiro Itagaki (Tokyo Univ. of Sci.) The dimension formula of the cyclic homology of truncated quiver algebras over a field of positive characteristic  
 Katsunori Sanada (Tokyo Univ. of Sci.)

概要 Taillefer gave the dimension formula of the cyclic homology of truncated quiver algebras over a field of characteristic zero. We show the dimension formula of the cyclic homology of truncated quiver algebras over an arbitrary field by means of a spectral sequence and chain maps given by Ames, Cagliero and Tirao. Our result generalizes the above result by Taillefer.

- 35 板場 綾子 (東京理大理) 二重矢を持つ巡回クイバーによる自己移入的 special biserial 多元環のホッホシルトコホモロジーについて ..... 10  
 Ayako Itaba (Tokyo Univ. of Sci.) On Hochschild cohomology of a self-injective special biserial algebra obtained by a circular quiver with double arrows

概要 We calculate the dimensions of the Hochschild cohomology groups of a self-injective special biserial algebra  $\Lambda_s$  obtained by a circular quiver with double arrows, and determine the Hochschild cohomology ring of  $\Lambda_s$  modulo nilpotence with the Yoneda product.

- 36 古谷 貴彦 (明海大 函) ホッホシルトコホモロジーに関するスナシャルの問題について ..... 10  
 速水 孝夫 (北海学園大工)  
 Takahiko Furuya (Meikai Univ.) On Snashall's question about Hochschild cohomology  
 Takao Hayami (Hokkai-Gakuen Univ.)

概要 The purpose of this talk is to study the Hochschild cohomology groups and rings for some finite-dimensional Koszul algebra  $A_t$  for integers  $t (\geq 3)$ . In fact we determine the dimensions of the Hochschild cohomology groups of  $A_t$ , and give a set of generators of the Hochschild cohomology ring modulo nilpotence of  $A_t$  as an algebra. This result tells us that the Hochschild cohomology ring modulo nilpotence of  $A_t$  is not finitely generated.

- 37 古賀寛尚 (筑波大数理物質) Clifford extensions ..... 15  
 Hirotaka Koga (Univ. of Tsukuba) Clifford extensions

概要 In this talk, we generalize the construction of Clifford algebras and introduce the notion of Clifford extensions. Clifford extensions are constructed as Frobenius extensions which are Auslander–Gorenstein rings if so is a base ring.

- 38 毛利出 (静岡大理) Ampleness of group actions on graded algebras ..... 15  
 上山健太 (静岡大理)  
 Izuru Mori (Shizuoka Univ.) Ampleness of group actions on graded algebras  
 Kenta Ueyama (Shizuoka Univ.)

概要 In this talk, we introduce a notion of ampleness of a group action  $G$  on a noetherian graded algebra  $A$ . We show that if  $S = k[x_1, \dots, x_d]$  is a polynomial algebra generated in degree 1, then a finite subgroup  $G \leq \mathrm{SL}(d, k)$  is ample for  $S$  if and only if  $S^G$  is an isolated singularity. Moreover, if  $S$  is an AS-regular algebra and  $G$  is a finite ample group acting on  $S$ , then we show that  $\mathrm{D}^b(\mathrm{tails} S^G) \cong \mathrm{D}^b(\mathrm{mod}(\nabla S) * G)$  where  $\nabla S$  is the Beilinson algebra of  $S$ .

- 39 浅芝秀人 (静岡大理) Gluing of derived equivalences along bimodules ..... 10  
 Hideto Asashiba (Shizuoka Univ.) Gluing of derived equivalences along bimodules

概要 Let  $\mathbb{k}$  be a field and consider the bicategory  $\mathbb{k}\text{-}\mathbf{Cat}^b$  of small  $\mathbb{k}$ -linear categories whose 1-morphisms are the bimodules over them (1-morphisms from  $A$  to  $B$  are the  $B$ - $A$ -bimodules  ${}_B M_A$ ) and whose 2-morphisms are the bimodule morphisms. We define a notion of derived equivalences and Grothendieck constructions for lax functors from a small category  $I$  to  $\mathbb{k}\text{-}\mathbf{Cat}^b$ , and have the following result: Let  $X, X'$  be lax functors  $I \rightarrow \mathbb{k}\text{-}\mathbf{Cat}^b$ . If  $X$  and  $X'$  are derived equivalent, then so are their Grothendieck constructions. This will be applied to triangular matrix algebras and tensor algebras of  $\mathbb{k}$ -species.

- 40 山中聡 (岡山大自然) On Frobenius polynomials in skew polynomial rings ..... 10  
 Satoshi Yamanaka (Okayama Univ.) On Frobenius polynomials in skew polynomial rings

概要 S. Endo and Y. Watanabe proved that every separable  $R$ -algebra which is a finitely generated projective  $R$ -module is a symmetric, hence a Frobenius  $R$ -algebra. However, K. Sugano showed that this is not always true in the case of ring extensions of non commutative rings. Y. Miyashita gave characterizations of a separable polynomial and a Frobenius polynomial in skew polynomial rings and he posed the following question: Is any separable polynomial in skew polynomial rings Frobenius? In this talk, we show some recent results with respect to this question in skew polynomial rings.

- 41 西 中 恒 和 (岡 山 商 大) On primitivity of group algebras of amalgamated free products ..... 10  
 Tsunekazu Nishinaka On primitivity of group algebras of amalgamated free products  
 (Okayama Shoka Univ.)

概要 Let  $R$  be a ring with the identity element. A ring  $R$  is right primitive if and only if there exists a faithful irreducible right  $R$ -module  $M_R$ . Formanek proved that if  $G$  be a free product of non-trivial groups (except  $G = \mathbf{Z}_2 * \mathbf{Z}_2$ ), then  $KG$  is primitive for any field  $K$ . In particular, if  $G$  is a free group then  $KG$  is primitive for any field  $K$ . Motivated by the result, Balogun gave a result on primitivity of group rings of amalgamated free product, and the present author obtained a result on primitivity of group rings of locally free groups. However, the above two results are not complete generalizations of Formanek's one. In this talk, by making use of our recent method, we shall state two theorems which are complete generalizations of Formanek's results on free products and on free groups, respectively.

#### 14:15~15:00

- 42 遠 藤 久 芳 (東 海 大 海 洋) 対をなす素数の存在特性に関する考察 ..... 10  
 Hisayoshi Endo (Tokai Univ.) Discussion on the characteristics of coupled primes

概要 A rational method to tackle simultaneously two different kinds of 2-tuple problem is introduced. The first problem is regarding the gaps with even numbers ( $= 2, 4, 6, \dots$ ) between coupled primes which is known as Polignac conjecture or twin prime problem. The second one is regarding the sum of coupled primes which is known as Goldbach problem. A set of probable prime function is introduced to highlight the specified relationships between the coupled numbers. The probability of the number of the couples is determined in terms of the function then it is modified to the probability of the coupled primes on the basis of the prime theory.

- 43 清 水 健 一 (賢明女子学院中高)\* SP number について ..... 10  
 Kenichi Shimizu On SP number  
 (Kenmei Girls' Junior and Senior High School)

概要 Let  $a$  be any divisor of a natural number  $d$  and  $b = d/a$ , then we call  $d$  SP number if  $(a + b)/n$  is a prime, where  $n = 2, 1, 4$  as  $d \equiv 1, 2, 3 \pmod{4}$ , respectively. We consider properties of SP number.

- 44 澤 正 憲 (名 大 情 報) Waring 問題に関する Hilbert のある定理と Ellison の誤り ..... 15  
 Masanori Sawa (Nagoya Univ.) On a theorem of Hilbert related to Waring's problem, and Ellison's error

概要 Waring's problem in number theory asks whether every natural number can be expressed as a sum of  $r$ -th powers of integers. The problem goes back to Edward Waring in 1770, as a natural generalization of Lagrange's four square theorem. After many efforts by hundreds of mathematicians, the problem was finally solved by Hilbert in 1909. A key step in Hilbert's proof was to show a lemma on the existence of a certain algebraic identity, called a Hilbert identity. In this talk, we shall review how such identities are closely connected with Waring's problem, and then point out Ellison's error in his proof of Hilbert's lemma.

**15:30~16:30 2014年度(第17回)代数学賞受賞特別講演**

古 庄 英 和 (名大多元数理) アソシエーターとその周辺

Hidekazu Furusho (Nagoya Univ.) Various topics around associators

概要 I will explain recent various topics related to associators. Particularly I will talk about 4 groups related to associators; the Grothendieck–Teichmüller group, the double shuffle group, the Kashiwara–Vergne group and the motivic Galois group.

**16:45~17:45 2014年度(第17回)代数学賞受賞特別講演**

吉 野 雄 二 (岡 山 大 理) Cohen–Macaulay modules over Cohen–Macaulay rings

Yuji Yoshino (Okayama Univ.) Cohen–Macaulay modules over Cohen–Macaulay rings

概要 I will present an introductory lecture on the theory of Cohen–Macaulay modules over Cohen–Macaulay rings. If possible, I will give some new results on the related topics.

3月18日(火) 第I会場

**9:00~12:00**

- 45 池 田 創 一 (名大多元数理)
- <sup>b</sup>
- Euler の二重ゼータ関数の特徴付け ..... 10

松 岡 謙 晶 (名大多元数理)

Soichi Ikeda (Nagoya Univ.) Characterization of the Euler double zeta function

Kaneaki Matsuoka (Nagoya Univ.)

概要 We give an analogue of Hamburger’s theorem for the Euler double zeta function.

- 46 松 岡 謙 晶 (名大多元数理)
- <sup>b</sup>
- Hardy 関数の導関数の二乗平均 ..... 10

Kaneaki Matsuoka (Nagoya Univ.) Mean values of the derivative of the Hardy function

概要 We discuss certain mean value of the derivative of the Hardy function.

- 47 スリアジャヤアデイルマ リーマン予想の下でのリーマンゼータ関数の
- $k$
- 階導関数の零点について ..... 15
- 
- (名大多元数理)

Ade Irma Suriajaya (Nagoya Univ.) On the zeros of the  $k$ -th derivative of the Riemann zeta function under the Riemann hypothesis

概要 The number of zeros and the distribution of the real part of non-real zeros of the derivatives of the Riemann zeta function have been investigated by Berndt, Levinson, Montgomery, and Akatsuka. Berndt, Levinson, and Montgomery investigated the general case, meanwhile Akatsuka gave sharper estimates for the first derivative of the Riemann zeta function under the truth of the Riemann hypothesis. In this paper, we generalize the results of Akatsuka to the  $k$ -th derivative (for positive integer  $k$ ) of the Riemann zeta function.

- 48 矢代好克 (名大多元数理)\* Cusp form に付随する  $L$ -関数の一般階導関数の近似関数等式と二乗平均 ..... 10  
 Yoshikatsu Yashiro (Nagoya Univ.) Approximate functional equation and mean value formula for the derivatives of  $L$ -function attached to cusp form

概要 Let  $f$  be a holomorphic cusp form of weight  $k$  with respect to  $SL_2(\mathbb{Z})$  which is a normalized Hecke eigenform,  $L_f(s)$  the  $L$ -function attached to the form  $f$ . In this talk, we shall give the approximate functional equation and mean value formula for the derivatives of  $L_f(s)$ .

- 49 K. Chakraborty \* An inequality for Hecke multiplicative functions ..... 10  
 (Harish-Chandra Research Inst.)  
 南出真 (京都産大理)  
 Kalyan Chakraborty An inequality for Hecke multiplicative functions  
 (Harish-Chandra Research Inst.)  
 Makoto Minamide  
 (Kyoto Sangyo Univ.)

概要 Let  $f$  be an arithmetical function satisfying  $f(m)f(n) = \sum_{d|(m,n)} f(mn/d^2)$ . Soundararajan gave an inequality for  $\sum_{n \leq x/y} |f(n)|^2$  ( $1 \leq y \leq x$ ) to settle the “Quantum ergodicity problem.” We will derive an inequality for  $\sum_{n \leq x/y} |f(n)|^k$  (for any  $k > 0$ ).

- 50 木内功 (山口大理工)\* Mean square formula for double zeta-function ..... 10  
 南出真 (京都産大理)  
 Isao Kiuchi (Yamaguchi Univ.) Mean square formula for double zeta-function  
 Makoto Minamide  
 (Kyoto Sangyo Univ.)

概要 We prove the mean square formula for the double zeta-function of Euler–Zagier type.

- 51 桂田昌紀 (慶大経済) Transformation formulae and asymptotic expansions for double holomorphic Eisenstein series of two variables ..... 10  
 野田工 (日大工)  
 Masanori Katsurada (Keio Univ.) Transformation formulae and asymptotic expansions for double holomorphic Eisenstein series of two variables  
 Takumi Noda (Nihon Univ.)

概要 We first introduce in the talk a certain double holomorphic Eisenstein series of two complex variables; its transformation formulae and asymptotic expansions, both involving confluent hypergeometric functions, are presented. Various closed form evaluations for specific values (at positive and negative integer lattice points) of the double Eisenstein series in question are further given upon yielding some ‘double analogues’ of the classical Kronecker limit formulae.

- 52 古屋 淳 (沖縄工高専)\* Mean values of the error term with shifted arguments in the circle problem ..... 10  
 谷川 好男 (名大多元数理) ..... 10  
 Jun Furuya Mean values of the error term with shifted arguments in the circle problem  
 (Okinawa Nat. Coll. of Tech.) ..... 10  
 Yoshio Tanigawa (Nagoya Univ.)

概要 In this talk, we show the relation between the shifted sum of the error term in the circle problem and its continuous mean. In particular, we obtain a certain expression of the shifted sum as a linear combination of the continuous mean with the Bernoulli polynomials as the coefficients.

- 53 谷川 好男 (名大多元数理)\* Mean square of the error term in the asymmetric many dimensional divisor problem ..... 10  
 Xiaodong Cao  
 (Beijing Inst. of Petro-Chemical Tech.)  
 Wenguang Zhai  
 (China Univ. of Minig and Tech.)  
 Yoshio Tanigawa (Nagoya Univ.) Mean square of the error term in the asymmetric many dimensional  
 Xiaodong Cao divisor problem  
 (Beijing Inst. of Petro-Chemical Tech.)  
 Wenguang Zhai  
 (China Univ. of Minig and Tech.)

概要 Let  $\Delta(\mathbf{a}; x)$  be the error term in the asymmetric many dimensional divisor problem. In this talk we show an asymptotic formula of the mean square of  $\Delta(\mathbf{a}; x)$  under a certain condition. In particular in the two and three dimensional cases, we give unconditional asymptotic formulas for these mean squares.

- 54 金子 元 (日大理工・JSPS) 正規数とその一般化について ..... 15  
 Hajime Kaneko (Nihon Univ./JSPS) On normal numbers and their generalizations

概要 Borel proved that almost all nonnegative real numbers are normal in any integral base  $b$ . Borel also conjectured that every algebraic irrational number is normal in any integral base  $b$ , which is still unsolved. On the other hand, Wall proved for any integer  $b \geq 2$  that each nonnegative real number  $\xi$  is normal if and only if the geometric progression  $\xi b^n$  ( $n = 0, 1, \dots$ ) is uniformly distributed modulo one. In this talk, we study the fractional parts of  $\xi \alpha^n$  ( $n = 0, 1, \dots$ ) for general algebraic integer  $\alpha > 1$  and algebraic numbers  $\xi$ , which generalizes the problem of the normality of algebraic irrational numbers in integral base  $b \geq 2$ .

- 55 田中 孝明 (慶大理工) A new class of Mahler functions ..... 10  
 Taka-aki Tanaka (Keio Univ.) A new class of Mahler functions

概要 Mahler's method gives algebraic independence results for the values of functions of several variables satisfying certain functional equations under the transformations of the variables represented as a kind of multiplicative action of matrices with integral entries. In the Mahler's method, the entries of those matrices must be nonnegative; however, in the special case, those matrices are admitted to have a negative entry. We show the algebraic independence of the values of certain functions satisfying functional equations under the transformation represented by such matrices.

- 56 池田 創一 (名大多元数理)\* Sheffer 列と補充公式 ..... 10  
 Soichi Ikeda (Nagoya Univ.) Sheffer sequences and supplementary formulas

概要 We study the supplementary formulas for the Sheffer sequences. As applications of that study, we consider characterizations of the Bernoulli, Euler and poly-Bernoulli polynomials.

- 57 小松 尚夫 (弘前大理工) A note on the denominators of Bernoulli numbers ..... 10  
 F. Luca (UNAM)  
 C. de J. Pita Ruiz V.  
 (Univ. Panamericana)  
 Takao Komatsu (Hirosaki Univ.) A note on the denominators of Bernoulli numbers  
 Florian Luca (UNAM)  
 Claudio de J. Pita Ruiz V.  
 (Univ. Panamericana)

概要 We show that  $\gcd(2!S(2n+1, 2), \dots, (2n+1)!S(2n+1, 2n+1)) = \text{denominator of } B_{2n}$ , where  $S(n, k)$  is the Stirling number of the second kind and  $B_n$  is the Bernoulli number.

- 58 宮崎 隆史 (日大理工)\* 連立ディオファントス方程式  $a^2 + b^2 = (m^2 + 1)^r$  と  $a^x + b^y = (m^2 + 1)^z$  について ..... 15  
 Takafumi Miyazaki (Nihon Univ.) On the system of Diophantine equations  $a^2 + b^2 = (m^2 + 1)^r$  and  $a^x + b^y = (m^2 + 1)^z$

概要 Let  $r, m$  be positive integers with  $r > 1$ ,  $m$  even, and  $A, B$  integers satisfying  $A + B\sqrt{-1} = (m + \sqrt{-1})^r$ . We prove that the Diophantine equation  $|A|^x + |B|^y = (m^2 + 1)^z$  has no positive integer solutions in  $(x, y, z)$  other than  $(x, y, z) = (2, 2, r)$ , whenever  $r > 10^{74}$  or  $m > 10^{34}$ . This result is an explicit refinement of a theorem due to F. Luca in 2012.

#### 14:15~16:45

- 59 奥山 裕介 (京都工繊大工芸) A quantitative logarithmic equidistribution in non-archimedean and complex dynamics ..... 15  
 Yūsuke Okuyama (Kyoto Inst. Tech.) A quantitative logarithmic equidistribution in non-archimedean and complex dynamics

概要 Let  $f \in K(z)$  be a rational function of degree more than one over an algebraically closed field  $K$  of characteristic 0 and complete with respect to a non-trivial and possibly non-archimedean absolute value  $|\cdot|$ . In this talk, we establish a quantitative approximation of the Lyapunov exponent  $L(f)$  of  $f$  with respect to the canonical measure  $\mu_f$  of  $f$  using the multipliers  $(f^n)'(w)$  of non-superattracting fixed points  $w$  of  $f^n$ ,  $n \in \mathbb{N}$ .

- 60 奥山 裕介 (京都工繊大工芸) Algebraic zeros divisors having small diagonals and small heights in adelic dynamics ..... 15  
 Yūsuke Okuyama (Kyoto Inst. Tech.) Algebraic zeros divisors having small diagonals and small heights in adelic dynamics

概要 Let  $k$  be a field, and  $k_s$  the separable closure of  $k$  in the algebraic closure  $\bar{k}$  of  $k$ . An algebraic zeros divisor  $(P)$  on the projective line  $\mathbb{P}^1(\bar{k})$  over  $\bar{k}$ , which is by definition the zeros divisor on  $\mathbb{P}^1(\bar{k})$  of a homogeneous polynomial  $P$  of two variables over  $k$ , generalizes both the Galois conjugacy class of a point in the affine line  $\mathbb{A}^1(\bar{k})$  over  $\bar{k}$  and the roots divisor of the equation  $f = a$  on  $\mathbb{P}^1(\bar{k})$  for distinct rational functions  $f, a \in k(z)$  satisfying  $\min\{\deg f, \deg a\} > 0$ . We will state a result on the asymptotic behavior of a sequence  $((P_n))$  of algebraic zeros divisors on  $\mathbb{P}^1(k_s)$  having small diagonals and small heights.

- 61 植松 哲也 (中大理工)  $p$  進体上の対角的 3 次曲面のゼロサイクルについて ..... 10  
 Tetsuya Uematsu (Chuo Univ.) On zero-cycles on diagonal cubic surfaces over  $p$ -adic fields

概要 The Chow groups of varieties are fundamental invariants in the study of their arithmetic and geometry. In this research, we explicitly compute the Chow group of zero-cycles on some diagonal cubic surfaces over  $p$ -adic fields by using Milnor- $K$ -theoretic symbolic generators of their Brauer groups constructed by Manin and the author, and by applying some results for the Brauer–Manin pairings due to Colliot-Thélène, Saito and Sato. Moreover, we find that some of them are generated only by the class of rational points. Besides symbolic generators and the Brauer–Manin pairings, a certain reduction to elliptic curves plays an important role in the proof of this result.

- 62 橋本 康史 (琉球大理)\* ペル型方程式が可解な判別式に関する類数 and の漸近的な挙動について .. 15  
 Yasufumi Hashimoto Asymptotic behaviors for sums of class numbers of discriminants with  
 (Univ. of Ryukyus) Pell-type equations

概要 In this presentation, we study asymptotic behaviors for sums of class numbers of discriminants which give soluble Pell-type equations.

- 63 田坂 浩二 (九大数理) モジュラー形式の周期の理論と多重ゼータ値の線形関係式について .... 10  
 Koji Tasaka (Kyushu Univ.) On periods of modular forms and linear relations among multiple zeta values

概要 It is known that there are linear relations over  $\mathbb{Q}$  among periods of elliptic modular forms which are called 2-cycle and 3-cycle relations developed by Eichler and Shimura. This theory often appears in the context of multiple zeta values. In 2006, Gangl, Kaneko and Zagier gave a direct correspondence between coefficients of a linear relation among periods and coefficients of a linear relation among double zeta values. Their result may well be generalized to the higher depth, however it is still pending. In my talk, we will show an indirect relationship between the period theory and multiple zeta values.



- 64 名越弘文 (群馬大理工)\* Combining three theorems on the joint universality of  $L$ -functions ..... 10  
 Hirofumi Nagoshi (Gunma Univ.) Combining three theorems on the joint universality of  $L$ -functions

概要 We combine Bagchi–Gonek–Voronin’s theorem, Laurinćikas–Matsumoto’s theorem and Mishou’s theorem, which are concerning the joint universality of  $L$ -functions.

- 65 小塚和人 (都城工高専)\* Dedekind 和についての Halbritter の公式の組合幾何学的考察 ..... 10  
 Kazuhito Kozuka A combinatorial-geometric approach to Halbritter’s formula for Dedekind  
 (Miyakonojo Nat. Coll. of Tech.) sums

概要 In this talk, as a generalization of reciprocity formulas for Dedekind sums, we consider the one due to Halbritter. We show how the formula is interpreted from a combinatorial-geometric viewpoint.

- 66 山崎愛一 (京大理) Class numbers and algebraic tori ..... 10  
 星明考 (新潟大理)  
 Ming-chang Kang (Nat. Taiwan Univ.)  
 Aiichi Yamasaki (Kyoto Univ.) Class numbers and algebraic tori  
 Akinari Hoshi (Niigata Univ.)  
 Ming-chang Kang (Nat. Taiwan Univ.)

概要 Let  $p$  be an odd prime number,  $D_p$  be the dihedral group of order  $2p$ ,  $h_p$  and  $h_p^+$  be the class numbers of  $\mathbb{Q}(\zeta_p)$  and  $\mathbb{Q}(\zeta_p + \zeta_p^{-1})$  respectively. Theorem.  $h_p^+ = 1$  if and only if, for any field  $k$  admitting a  $D_p$ -extension, all the algebraic tori over  $k$  and split by some dihedral extension  $K/k$  are always stably rational. A similar result for  $h_p = 1$  and  $C_p$ -tori is valid also.

- 67 杉山真吾 (阪大理)\* 相対跡公式と Hilbert モジュラー形式の  $L$  関数の劣凸評価 ..... 10  
 都築正男 (上智大理工)  
 Shingo Sugiyama (Osaka Univ.) Relative trace formulas and subconvexity estimates of  $L$ -functions for  
 Masao Tsuzuki (Sophia Univ.) Hilbert modular forms

概要 Ramakrishnan and Rogawski gave an asymptotic formula for a mean of central  $L$ -values attached to the imaginary quadratic base change of elliptic holomorphic cusp forms with prime level as the level tends to infinity. Feigon and Whitehouse extended their result to the case of Hilbert cusp forms with square free level when the quadratic extension involved is totally imaginary. In this talk, we report our recent generalization of their asymptotic formula for Hilbert cusp forms to arbitrary levels, dropping the totally imaginary condition of the quadratic extension at the same time. As an application of this, we obtain a subconvexity bound of quadratic base change  $L$ -functions for Hilbert cusp forms in the weight aspect. This is a joint work with Masao Tsuzuki (Sophia University).

- 68 水澤靖 (名工大)\* 実 2 次体の  $\mathbb{Z}_2$  拡大と準二面体型 2-類体塔 ..... 10  
 Yasushi Mizusawa Semidihedral 2-class field towers and  $\mathbb{Z}_2$ -extensions of real quadratic  
 (Nagoya Inst. of Tech.) fields

概要 We show that the Galois group of the maximal unramified pro-2-extension over the  $\mathbb{Z}_2$ -extension of a real quadratic field is never isomorphic to a semidihedral group.

- 69 水澤 靖 (名 工 大)\* 有限体の等長埋め込み ..... 10  
 Yasushi Mizusawa Isometric embeddings of finite fields  
 (Nagoya Inst. of Tech.)

概要 By regarding a finite field as a vector space over the prime field with a power basis, a Hamming distance is defined on the finite field with respect to the power basis. We give an equivalent condition of existence of isometric homomorphisms between such finite fields of characteristic 2.

- 70 小島 彰太 (立 教 大 理) 多重平方根とポアンカレ関数 ..... 10  
 青木 昇 (立 教 大 理)  
 Shota Kojima (Rikkyo Univ.) Nested square roots and Poincaré functions  
 Noboru Aoki (Rikkyo Univ.)

概要 Nested square roots of 2 are expressed by using a trigonometric function and its zeros. This result was obtained by Wiernsberger and Lebesgue. In this talk, we give an expression of nested square roots of  $c > 2$  by using a Poincaré function and its zeros.

## 幾 何 学

3月15日(土) 第VII会場

9:20~12:00

- 1 蛭子井博孝 About Descartes Oval as the pure extension of Ellipse ..... 5  
(Oval Research Center)

Hiroataka Ebisui (Oval Research Center) About Descartes Oval as the pure extension of Ellipse

概要 Theoretical extension of ellipse to 4th order curve (Descartes Oval named as Doval) have not been expressed yet. Now we got them by Geomebra Soft and its figure. We can show Doval is the theoretical extension of Ellipse that is exchanged from “line” (infinity radius circle) to “circle” in the Ellipse-definition: the curve that has constant ratio between two distance from fixed point and fixed “line”. We know the importance of Ellipse in many field. Now we can say that Doval is the same position as Ellipse.

- 2 前田定廣(佐賀大理工)\* 非平坦複素空間形内のリッチテンソルが $\eta$ -平行なホップ超曲面の分類定理 ..... 15

Sadahiro Maeda (Saga Univ.) Classification theorems of Hopf hypersurfaces with  $\eta$ -parallel Ricci tensor in a nonflat complex space form

概要 We classify Hopf hypersurfaces with  $\eta$ -parallel Ricci tensor in a nonflat complex space form  $\widetilde{M}_n(c)$ ,  $n \geq 2$ . Note that there exist nonhomogeneous Hopf hypersurfaces with  $\eta$ -parallel Ricci tensor in  $\widetilde{M}_2(c)$ ,  $c \neq 0$ .

- 3 前田定廣(佐賀大理工)\* 複素双曲型空間内の3つの等質実超曲面の特徴付け ..... 15

Sadahiro Maeda (Saga Univ.) Characterizations of three homogeneous real hypersurfaces in a complex hyperbolic space

概要 We characterize the horosphere, the homogeneous real hypersurface of type (B) having two distinct constant principal curvatures and the homogeneous ruled real hypersurface in a complex hyperbolic space.

- 4 馬場蔵人(福島工高専) 半単純擬リーマン対称空間のs表現の局所軌道型について ..... 15

Kurando Baba Local orbit types of the s-representations for semisimple pseudo-Riemannian symmetric spaces

概要 We list up all the possible local orbit types of hyperbolic or elliptic orbits for the s-representations of semisimple pseudo-Riemannian symmetric spaces. It is key to give a recipe to determine the local orbit types of hyperbolic principal orbits by using three kinds of Satake diagrams associated with semisimple pseudo-Riemannian symmetric spaces.

- 5 栗原博之 (茨城大教育) 例外型コンパクト 4-対称空間の対合的自己同型 ..... 15  
 東條晃次 (千葉工大工)  
 Hiroyuki Kurihara (Ibaraki Univ.) Involutions on a compact 4-symmetric space of exceptional type  
 Koji Tojo (Chiba Inst. of Tech.)

概要 Let  $(G/H, \sigma)$  be a compact 4-symmetric space of inner and exceptional type. Suppose that the dimension of the center of  $H$  is one and  $H$  is not a centralizer of a toral subgroup. In this talk, we talk about the classification of involutions  $\tau$  of  $G$  satisfying  $\tau\sigma = \sigma\tau$ .

- 6 小池直之 (東京理大理) 概自由なリー群作用をもつヒルベルト空間内の不変超曲面を發する平均  
 曲率流 ..... 15  
 Naoyuki Koike (Tokyo Univ. of Sci.) The mean curvature flow starting from an invariant hypersurface in a  
 Hilbert space with an almost free Lie group action

概要 In this talk, we state some results for the (regularized) mean curvature flow starting from invariant hypersurfaces in a Hilbert space equipped with an isometric almost free Hilbert Lie group action whose orbits are minimal regularizable submanifolds. First we prove that the (regularized) mean curvature flow starting from a certain kind of invariant hypersurface uniquely exists in short time. Next I state the evolution equation for some geometric quantities along the regularized mean curvature flow. Also, by using the evolution equations, we prove a horizontally strongly convexity preservability theorem for the regularized mean curvature flow. From this theorem, we derive the strongly convexity preservability theorem for the mean curvature flow starting from a compact Riemannian suborbifold in the orbit space (which is a Riemannian orbifold) of the Hilbert Lie group action.

- 7 藤井 忍 (大島商船高専) 球面内の等径超曲面と運動量写像 —Grassmann 多様体の場合— ..... 15  
 Shinobu Fujii Moment maps and isoparametric hypersurfaces in spheres —Grassmann-  
 (Oshima Nat. Coll. of Maritime Tech.) ian cases—

概要 We are studying a relationship between isoparametric hypersurfaces in spheres with four distinct principal curvatures and the moment maps of certain Hamiltonian actions. In this talk, we consider the isoparametric hypersurfaces obtained from the isotropy representations of Grassmannian manifolds of rank two.

- 8 久保 亮 (広島大理) 複素双曲空間への polar 作用の幾何 ..... 10  
 Akira Kubo (Hiroshima Univ.) Geometry of polar actions on complex hyperbolic spaces

概要 An isometric action on a Riemannian manifold is said to be *polar* if there exists a complete connected closed submanifold which meets all the orbits and intersects them orthogonally. In this talk, I will talk about polar actions without singular orbits on complex hyperbolic spaces, and minimality of their orbits.

- 9 橋 本 要 (阪市大数学研) 球面の等質超曲面から構成される特殊ラグランジュ部分多様体の分類 .. 10  
 間 下 克 哉 (法 政 大)  
Kaname Hashimoto (Osaka City Univ.) Classification of special Lagrangian submanifolds constructed from ho-  
Katsuya Mashimo (Hosei Univ.) mogeneous hypersurfaces of the sphere

概要 It is known that there exist  $SO(n+1)$ -invariant complete Ricci-flat Kähler metrics on the cotangent bundle  $T^*S^n$  of the standard sphere  $S^n$ , so called the Stenzel metrics. We are studying cohomogeneity one special Lagrangian submanifolds in the cotangent bundle of the sphere with respect to the Stenzel metric. In this talk, we discuss a description of all cohomogeneity one special Lagrangian submanifolds which are invariant under the group actions induced by isotropy representations of Riemannian symmetric spaces of rank 2.

- 10 酒 井 高 司 (首都大東京理工) 極小 R 空間上の面積最小錐 ..... 15  
 大 野 晋 司 (首都大東京理工)  
Takashi Sakai (Tokyo Metro. Univ.) Area-minimizing cones over minimal R-spaces  
Shinji Ohno (Tokyo Metro. Univ.)

概要 We study area-minimizing cones in the Euclidean space constructing area-nonincreasing retractions. We obtain new examples of area-minimizing cone over minimal R-spaces.

#### 14:30~15:25

- 11 大 栗 正 弘 (中 大 理 工)\* チェビシェフベクトル場が null である 3 次元局所等質非退化中心アファ  
 イン超曲面 ..... 10  
Masahiro Ooguri (Chuo Univ.) Three-dimensional locally homogeneous nondegenerate centroaffine hy-  
 persurfaces with null Tchebychev vector field

概要 We determine three-dimensional locally homogeneous nondegenerate centroaffine hypersurfaces with null Tchebychev vector field.

- 12 谷 口 哲 也 (北里大一般教育) Characterizations of Ricci flat metrics and Lagrangian submanifolds in  
 宇 田 川 誠 一 (日 大 医) terms of the variational problem ..... 10  
Tetsuya Taniguchi (Kitasato Univ.) Characterizations of Ricci flat metrics and Lagrangian submanifolds in  
Seiichi Udagawa (Nihon Univ.) terms of the variational problem

概要 In this paper, we introduce a new variational problem on the space  $\mathfrak{T}_2^0 \times \mathfrak{T}_2^{0*}$  of the tensor product of the bundle of smooth  $(0, 2)$ -tensors and the bundle of smooth  $(0, 2)$ -tensors with non-zero determinant. Given a  $(P, \eta) \in \mathfrak{T}_2^0 \times \mathfrak{T}_2^{0*}$ , fixing  $P$  we consider the functional  $E(\eta)$ . Varying the tensor  $\eta$ , we calculate the 1st and 2nd variational formulae for the variational problem.

- 13 長谷川 和志 (金沢大人間社会) The first Chern class and conformal area for a twistor holomorphic immersion ..... 10  
 Kazuyuki Hasegawa (Kanazawa Univ.) The first Chern class and conformal area for a twistor holomorphic immersion

**概要** We obtain an inequality involving the first Chern class of the normal bundle and the conformal area for a twistor holomorphic surface. Using this inequality, we can improve an inequality obtained by T. Friedrich for the Euler class of the normal bundle of a twistor holomorphic surface in the four-dimensional space form. Moreover, as a corollary, we see that the area of a superminimal surface in the unit sphere is an integer multiple of  $2\pi$ , which is essentially proved by E. Calabi.

- 14 伊藤 光弘 (筑波大数理物質) Barycenter and information geometry ..... 10  
 佐藤 弘康 (東京電機大情報環境)  
 Mitsuhiro Itoh (Univ. of Tsukuba) Barycenter and information geometry  
 Hiroyasu Satoh (Tokyo Denki Univ.)

**概要** By applying barycenter of probability measures on the ideal boundary of an Hadamard manifold  $X$  we obtain a theorem which states that under certain assumptions a homeomorphism  $\Phi$  of the ideal boundary yields a Riemannian isometry of  $X$ .

#### 15:40~16:40 特別講演

- 川上 裕 (山口大理工) 曲面のガウス写像の値分布  
 Yu Kawakami (Yamaguchi Univ.) Value distribution of the Gauss map of surfaces

**概要** We elucidate the geometric background of function-theoretic properties (e.g. ramification theorem, unicity theorem) for the Gauss maps of several classes of immersed surfaces in three-dimensional space forms, for example, minimal surfaces in Euclidean three-space, flat surfaces in hyperbolic three-space and improper affine spheres in the affine three-space.

3月16日(日) 第VII会場

#### 9:40~11:50

- 15 伊藤 仁一 (熊本大教育) Cut locus structure on graphs ..... 15  
 C. Vilcu (IMRA, Bucharest)  
 Jin-ichi Itoh (Kumamoto Univ.) Cut locus structure on graphs  
 Costin Vilcu (IMRA, Bucharest)

**概要** Motivated by a fundamental geometrical object, cut locus, we introduce and study a new combinatorial structure on graphs, called cut locus structure. We present all distinct cut locus structures on 3-graphs with 2 or 3 generating cycles.

- 16 S. V. Sabau (東海大生物理工) 閉 3 次元多様体上の一般フィンスラー構造 ..... 15  
 渋谷 一博 (広島大理)  
G. Pitis (Transylvania Univ.)  
Sorin Vasile Sabau (Tokai Univ.) Generalized Finsler structures on closed 3-manifolds  
Kazuhiro Shibuya (Hiroshima Univ.)  
Gheorghe Pitis (Transylvania Univ.)

**概要** An  $(I, J, K)$ -generalized Finsler structure on a 3-manifold is a generalization of a Finslerian structure, introduced by R. Bryant in order to separate and clarify the local and global aspects in Finsler geometry making use of Cartan's method of exterior differential systems. In this talk, we show that there is a close relation between  $(I, J, 1)$ -generalized Finsler structures and a class of contact circles, namely the so-called *Cartan structures*. This correspondence allows us to determine the topology of 3-manifolds that admit  $(I, J, 1)$ -generalized Finsler structures and to single out classes of  $(I, J, 1)$ -generalized Finsler structures induced by standard Cartan structures.

- 17 井ノ口 順一 (山形大理) 離散 mKdV 方程式と離散 sine-Gordon 方程式による空間離散曲線の変形 ..... 15  
 梶原 健司 (九大IMI)  
 松浦 望 (福岡大理)  
 太田 泰広 (神戸大理)  
Jun-ichi Inoguchi (Yamagata Univ.) Discrete mKdV and discrete sine-Gordon flows on discrete space curves  
Kenji Kajiwara (Kyushu Univ.)  
Nozomu Matsuura (Fukuoka Univ.)  
Yasuhiro Ohta (Kobe Univ.)

**概要** We investigate discrete deformations of discrete space curves with constant torsion, and present a formula which describes torsion-preserving deformation. Especially, we show that the direction of the deformation is determined by the discrete mKdV equation or the discrete sine-Gordon equation at each time-step. We also show that our formula produces the discrete  $K$ -surfaces, which is a discrete analogue of the surfaces with constant negative Gaussian curvature.

- 18 前田 瞬 (秀明大) Chen 予想と 3 重調和部分多様体 ..... 15  
 浦川 肇 (東北大国際教育)  
 中内 伸光 (山口大理工)  
Shun Maeta (Shumei Univ.) Chen's conjecture and triharmonic submanifolds  
Hajime Urakawa (Tohoku Univ.)  
Nobumitsu Nakauchi  
 (Yamaguchi Univ.)

**概要** A triharmonic map is a critical point of the 3-energy in the space of smooth maps between two Riemannian manifold. We study the generalized Chen's conjecture for a triharmonic isometric immersion  $\varphi$  into a space form of non-positively constant curvature. We show that if the domain is complete and both the 4-energy of  $\varphi$ , and the  $L^4$ -norm of the tension field  $\tau(\varphi)$ , are finite, then such an immersion  $\varphi$  is minimal.

- 19 坂 田 繁 洋 (首都大東京理工) 体の中心の一意性と心臓の幾何学 ..... 15  
 Shigehiro Sakata (Tokyo Metro. Univ.) Uniqueness of a center of a body and geometry of the heart

概要 We consider the dual intrinsic volume of order  $\alpha$  of a convex body  $K$  and investigate the uniqueness of its maximum point. It is easy to show that the dual intrinsic volume is proportional to the Riesz potential. Using the moving plane method, we can restrict the location of a maximum point of the Riesz potential into a smaller region in  $K$ , which is called the heart of  $K$ . Using geometric properties of the heart of  $K$ , we give a sufficient condition for the uniqueness of a maximum point of the Riesz potential.

- 20 近 藤 慶 (東 海 大 理) フィンズラー幾何学における有限位相型定理と  $\mathbb{R}^n$  への微分同型定理 .. 15  
 Kei Kondo (Tokai Univ.) The finite topological types and diffeomorphism theorems to Euclidean space in Riemann–Finsler geometry

概要 I am going to introduce our several theorems called the finite topological type, and ones on a diffeomorphism to Euclidean space for Riemann–Finslerian manifolds in this talk.

- 21 酒 匂 宏 樹 (東 海 大 理) ケーリー位相と粗い幾何学 第一部: 従順群の埋め込みについて ..... 15  
 見 村 万 佐 人 (東 北 大 理)  
 Hiroki Sako (Tokai Univ.) Group approximation in Cayley topology and coarse geometry, Part I:  
 Masato Mimura (Tohoku Univ.) Coarse embeddings of amenable groups.

概要 Objective of this series is to study metric geometric properties of coarse disjoint union of Cayley graphs. We employ the Cayley topology and observe connection between large scale structure of metric spaces and group properties of Cayley limit points. In this part I, we prove that a coarse disjoint union has property A of G. Yu if and only if all Cayley limit groups are amenable. As an application, we construct a coarse disjoint union of finite special linear groups which has property A but is of very poor compression into all uniformly convex Banach spaces.

### 13:00~14:00 特別講演

- 船 野 敬 (京 大 理) リーマン多様体上のラプラシアン固有値と多重等周定数について  
 Kei Funano (Kyoto Univ.) Eigenvalues of Laplacian and multi-way isoperimetric constants on Riemannian manifolds

概要 In this talk, I will discuss the distribution of eigenvalues of the weighted Laplacian on closed weighted Riemannian manifolds of nonnegative Bakry–Émery Ricci curvature. As an application of the curvature dimension condition, I will derive some universal inequalities among eigenvalues of the weighted Laplacian on such manifolds. These inequalities are quantitative versions of the previous theorem by the speaker with Shioya. I will also discuss some geometric quantity, called multi-way isoperimetric constants, on such manifolds and obtain similar universal inequalities among them. Multi-way isoperimetric constants are generalizations of the Cheeger constant. I will explain the relation between the  $k$ -th eigenvalue and the  $k$ -way isoperimetric constant.



## 3月17日(月) 第VII会場

## 10:00~11:50

- 22 廣田 祐士 (東京理大理) Dirac 多様体の前量子化について ..... 15  
 Yuji Hirota (Tokyo Univ. of Sci.) On prequantization of Dirac manifolds

概要 In this talk, we study the prequantization problem to manifolds with Dirac structures, called a Dirac manifolds. After reviewing the foundations of Dirac manifolds, we endow the space of admissible functions with Poisson structure in a different way from the usual and construct the representation of the space of admissible functions. Additional to this, we provide a necessary and sufficient condition for the non-commutative brackets to be preserved under the representation.

- 23 興津 優史 (東工大理工) 弱凸接触トーリック多様体の構成 ..... 10  
 Yushi Okitsu (Tokyo Tech) The cutting construction of weakly convex contact toric manifolds

概要 We introduce the cutting construction of toric symplectic cones that correspond to a weakly convex good cone. Since the symplectization of a toric contact manifold is a toric symplectic cone, we can also construct toric contact manifolds that correspond to a weakly convex good cone by the cutting construction. (Note that these toric contact manifolds can not be constructed by Delzant construction.) We further prove there are no toric Sasakian structures on these contact manifolds. From this, contact toric manifolds of K-contact type are of toric Sasakian type.

- 24 只野 誉 (阪大理) Gap theorems for compact gradient Sasaki–Ricci solitons ..... 15  
 Homare Tadano (Osaka Univ.) Gap theorems for compact gradient Sasaki–Ricci solitons

概要 In this talk we give some necessary and sufficient conditions for compact gradient Sasaki–Ricci solitons to be Sasaki–Einstein. Our result [3] may be considered as a Sasaki geometry version of recent works by H. Li [2] and M. Fernández-López and E. García-Río [1].

References

- [1] M. Fernández-López and E. García-Río, *Some gap theorems for gradient Ricci solitons*, Internat. J. Math., **23** (2012), no. 7, 1250072, 9 pages.  
 [2] H. Li, *Gap theorems for Kähler–Ricci solitons*, Arch. Math. (Basel), **91** (2008), no. 2, 187–192.  
 [3] H. Tadano, *Gap theorems for compact gradient Sasaki–Ricci solitons*, preprint, 2013.

- 25 野沢 啓 (立命館大理工) Lie 葉層の剛性について ..... 15  
 G. Meigniez (Univ. Bretagne-Sud)  
 Hiraku Nozawa (Ritsumeikan Univ.) On rigidity of Lie foliations  
 Gaël Meigniez (Univ. Bretagne-Sud)

概要 A Lie foliation  $\mathcal{F}$  is transversely modeled on a Lie group  $G$  with the canonical left  $G$ -action. Lie foliations have been studied motivated by the fact that the classification of Riemannian foliations is reduced to the case of Lie foliations by Molino theory. In this talk, we will present a rigidity result for Lie foliations whose leaves are symmetric spaces which do not have a Poincaré disk as an irreducible component. It says that such foliation is homeomorphic to a foliation on a double coset space whose leaves are cosets. The result can be regarded as an improvement of a preceding result of Zimmer.

- 26 多羅間大輔 (京大 理)\* Analytic extension of Birkhoff normal forms for  $SO(3)$  free rigid body dynamics ..... 15  
 Daisuke Tarama (Kyoto Univ.) Analytic extension of Birkhoff normal forms for  $SO(3)$  free rigid body dynamics

**概要** Birkhoff normal form is a power series expansion associated with the local behavior of the Hamiltonian systems near a critical point. It is known to be convergent for integrable systems under some non-degeneracy conditions. By means of an expression of the inverse of Birkhoff normal form by a period integral, analytic continuation of the Birkhoff normal forms is considered for the free rigid body dynamics on  $SO(3)$ . The global behavior of the Birkhoff normal forms is clarified in relation to the monodromy of an elliptic fibration which naturally arises from the free rigid body dynamics.

- 27 牛島 顕 (金沢大 理工) 底面が共通な三次元双曲 complete orthoscheme の最大体積について .. 10  
 市原 一裕 (日大 文理)  
 Akira Ushijima (Kanazawa Univ.) On the maximal volume of three-dimensional hyperbolic complete or-  
 Kazuhiro Ichihara (Nihon Univ.) thoschemes sharing the same base

**概要** A three-dimensional orthoscheme is defined as a tetrahedron whose base is a right-angled triangle and an edge joining the apex and a non-right-angled vertex is perpendicular to the base. A generalization, called complete orthoschemes, of orthoschemes is known in hyperbolic geometry. Roughly speaking, complete orthoschemes consist of three kinds of polyhedra; either compact, ideal or truncated. We consider a particular family of hyperbolic complete orthoschemes, which share the same base. They are parametrized by the “height”, which represents how far the apex is from the base. We prove that the volume attains maximal when the apex is ultraideal in the sense of hyperbolic geometry, and that such a complete orthoscheme is unique in the family.

#### 14:20~15:20 特別講演

- 楯 辰哉 (東北大 理) 一次元・二次元の量子ウォーク  
 Tatsuya Tate (Tohoku Univ.) One and two dimensional quantum walks

**概要** The notion of discrete-time quantum walks are defined as a non-commutative analogue of the usual random walks. These are intensively investigated in computer sciences, probability theory and quantum physics. Recently, in a joint work with T. Sunada, the author obtained various local asymptotic formulas for the one-dimensional discrete-time quantum walks. From this, one obtains a concrete formula of the rate function for the large deviation of discrete-time quantum walks. In the beginning of the talk, these asymptotic result for one-dimensional quantum walks will be roughly explained. There are another notion of the quantum walks, namely continuous-time quantum walks. These are defined as a unitary evolution for the transition operators of classical random walks. It was asked by Ambainis in computer sciences the relation between continuous-time and discrete-time random walks. In the talk, a direct relation between two object for one-dimension will be explained. In a high-dimensional case, there are only a few result are known. According to a recent result, the one-dimensional discrete-time quantum walks are obtained from the regular representation of the infinite dihedral group. In the talk, certain class of two-dimensional quantum walks are introduced using a representation of a discrete group. Asymptotic results for these class of quantum walks are not obtained, but some properties will be presented in the talk.

# 函 数 論

3月15日(土) 第VIII会場

9:30~11:45

- 1 西 本 勝 之 (デカルト出版)\* The integral Contour of N-fractional calculus, interval of fractional integral of Riemann–Liouville and that of Weyl, and N-fractional calculus of some functions ..... 15  
 Katsuyuki Nishimoto The integral Contour of N-fractional calculus, interval of fractional integral of Riemann–Liouville and that of Weyl, and N-fractional calculus of some functions  
 (Descartes Press Co.)

概要 In this article, the integral contours  $C = \{C_-, C_+\}$  of the N-fractional calculus, the integral interval of the fractional integral of Riemann–Liouville and that of Weyl are discussed.

And the N-fractional calculus of order  $\gamma$  and  $n(\in \mathbf{Z}_0^+)$ th derivatives of a composite function are reported. Moreover, some identities are reported which are obtained by the calculations

$$(((z-b)^4 - c)^{-1})_\gamma = (((z-b)^4 - c)^{-2} \cdot ((z-b)^4 - c))_\gamma$$

and

$$(((z-b)^4 - c)^{-1})_\gamma = (((z-b)^4 - c)^{-1})_{\gamma-1}$$

for example.

- 2 米 田 力 生 (小 樽 商 大)\* 可逆なテーパーリッツ作用素とベリジン変換 ..... 10  
 Rikio Yoneda The invertible Toeplitz operator and the Berezin transform  
 (Otaru Univ. of Commerce)

概要 In this talk, we study the invertible Toeplitz operator.

- 3 相 川 弘 明 (北 大 理) Intrinsic ultracontractivity and the boundary Harnack principle —A unified approach with capacity width— ..... 15  
 Hiroaki Aikawa (Hokkaido Univ.) Intrinsic ultracontractivity and the boundary Harnack principle —A unified approach with capacity width—

概要 The semigroup associated with the Dirichlet heat kernel is said to be intrinsic ultracontractive if the Dirichlet realization of the associated self adjoint operator has the first positive eigenvalue with positive  $L^2$  eigenfunction; and the heat kernel is bounded above and below by the product of the eigenfunctions with positive multiplicative constants depending on time.

We give a sharp sufficient integral condition for intrinsic ultracontractivity in terms of capacity width with the aid of a parabolic box argument. A similar integral condition for the boundary Harnack principle is also obtained.

- 4 柴 雅 和 (広島 大\*) 開リーマン面の開リーマン面への等角的埋め込み —実現された理想境界  
 山口 博 史 (滋 賀 大\*) の形状— ..... 15  
 Masakazu Shiba (Hiroshima Univ.\*) Compact continuations of an open Riemann surface —the shape of the  
 Hiroshi Yamaguchi (Shiga Univ.\*) realized ideal boundary—

概要 Let  $R$  be an open Riemann surface of finite genus, and  $\Phi$  an Abelian integral on  $R$  which satisfies certain conditions similar to the classical extremal parallel slit mappings. Then,  $R$  is extended to a compact Riemann surface  $S$  of the same genus and  $\Phi$  is continued to an Abelian integral  $\Psi$  on  $S$ , in such a way that  $\Psi$  is holomorphic on the realized ideal boundary  $E := S \setminus R$ . Theorem: For any component  $\delta$  of  $E$  the number of zeros of  $d\Psi$  on  $\delta$  is constant for all  $\Psi$ 's, provided that  $\Phi$ 's have the same singularities and the same periods.

- 5 下 村 健 吾 (阪 大 情 報) 三角群の変形と反復関数系 ..... 15  
 嶺 山 良 介 (阪 大 理)  
 Kengo Shimomura (Osaka Univ.) Deformation of a triangle group and the iterated function system  
 Ryosuke Mineyama (Osaka Univ.)

概要 Triangle groups can be regarded as Coxeter groups. Classically it is known that Coxeter groups are equipped with actions on vector spaces as like reflections. In this talk we will talk that the projection of such classical action of a triangle group induce some iterated function system. Concretely we shall introduce how the variation of the Hausdorff dimension of the limit set of a triangle group  $W = \langle s_0, s_1, s_2 \mid s_0^2 = s_1^2 = s_2^2 = 1 \rangle$  depends continuously on the deformation of  $W$ .

- 6 金 城 絵 利 那 (東工大情報理工) On Teichmüller metric and the length spectrums of Riemann surfaces  
 of infinite type ..... 15  
 Erina Kinjo (Tokyo Tech) On Teichmüller metric and the length spectrums of Riemann surfaces  
 of infinite type

概要 We consider the metric  $d_L$  on Teichmüller spaces defined by the length spectrums of Riemann surfaces. It is known that the metric  $d_L$  defines the same topology as that of Teichmüller metric  $d_T$  on Teichmüller spaces of Riemann surfaces of finite type. In 2003, H. Shiga proved that there exists a Teichmüller space  $T(R_0)$  of Riemann surface of infinite type such that  $d_L$  and  $d_T$  do not define the same topology on  $T(R_0)$ . Also he gave a sufficient condition for  $d_L$  and  $d_T$  to define the same topology on Teichmüller space. In this talk, we extend Shiga's result to Teichmüller spaces satisfying a certain geometric condition.

- 7 井 口 雄 紀 (東工大理工) タイヒミュラー測地線の集積点について ..... 15  
 Yuki Iguchi (Tokyo Tech) On accumulation points of Teichmüller geodesics

概要 We investigate accumulation points of arbitrary Teichmüller geodesic rays in Thurston's compactification of a Teichmüller space. We find a boundary point to which no ray accumulates. We also showed that an accumulation point of a geodesic is represented by a measured foliation which has the same minimal decomposition of the measured foliation associated with the geodesic.

- 8 四之宮佳彦 (東工大理工) Veech 曲面の周期点について ..... 15  
 Yoshihiko Shinomiya (Tokyo Tech) Periodic points on Veech surfaces

概要 A periodic point on a Veech surface is a point whose orbit under the affine group is finite. The number of periodic points on a non-arithmetic Veech surface is finite. We give upper bounds of the numbers of periodic points that depend only on the topological type of Veech surfaces and signatures of the Veech groups.

#### 14:15~15:45

- 9 本田 竜 広 (広島工大工) Growth and distortion theorems on homogeneous unit balls ..... 15  
 濱田 英 隆 (九州産大工)  
 G. Kohr (Babeş-Bolyai Univ.)  
 Tatsuhiro Honda Growth and distortion theorems on homogeneous unit balls  
 (Hiroshima Inst. of Tech.)  
 Hidetaka Hamada  
 (Kyushu Sangyo Univ.)  
 Gabriela Kohr (Babeş-Bolyai Univ.)

概要 In this talk, we obtain growth and distortion theorems for linearly invariant families  $\mathcal{F}$  of locally biholomorphic mappings on the homogeneous unit ball  $B$  of an  $n$ -dimensional complex Banach space  $X$  with finite norm-order. Note that the reason for which we use the Euclidean norm  $\|\cdot\|_e$  for the target space instead of the norm on  $X$  is that we are able to obtain lower bounds in the two-point distortion theorems for linearly invariant families on any homogeneous unit ball in  $\mathbb{C}^n$ . Next, we obtain similar results for affine and linearly invariant families of pluriharmonic mappings of the unit ball  $B$  into  $\mathbb{C}^n$ .

- 10 M. Chuaqui Pluriharmonic mappings and linearly connected domains in  $\mathbb{C}^n$  ..... 15  
 (Catholic Univ. of Chile)  
 濱田 英 隆 (九州産大工)  
 R. Hernández (Univ. Adolfo Ibáñez)  
 G. Kohr (Babeş-Bolyai Univ.)  
 Martin Chuaqui Pluriharmonic mappings and linearly connected domains in  $\mathbb{C}^n$   
 (Catholic Univ. of Chile)  
 Hidetaka Hamada  
 (Kyushu Sangyo Univ.)  
 Rodrigo Hernández  
 (Univ. Adolfo Ibáñez)  
 Gabriela Kohr (Babeş-Bolyai Univ.)

概要 In this talk, we obtain certain sufficient conditions for the univalence of pluriharmonic mappings defined in the unit ball  $\mathbb{B}^n$  of  $\mathbb{C}^n$ . The results are generalizations of conditions of Chuaqui and Hernández that relate the univalence of planar harmonic mappings with linearly connected domains, and show how such domains can play a role in questions regarding injectivity in higher dimensions.

**概要** In this talk, we consider univalent subordination chains in reflexive complex Banach spaces, allowing the chains to be normalized in terms of a positive linear operator. Related adaptations in the generalized Loewner differential equation are also considered. The results in this talk are generalizations to reflexive complex Banach spaces of classical and recent results in the theory of Loewner chains and the Loewner differential equation on the unit ball in  $\mathbb{C}^n$ .

**概要** Under the assumption  $k_+(A) < 2m(A)$ , where  $A \in L(\mathbb{C}^n)$ , we consider the family  $S_A^0(B^n)$  of mappings which have  $A$ -parametric representation on the Euclidean unit ball  $B^n$  in  $\mathbb{C}^n$ , i.e.  $f \in S_A^0(B^n)$  if and only if there exists an  $A$ -normalized univalent subordination chain  $f(z, t)$  such that  $f = f(\cdot, 0)$  and  $\{e^{-tA}f(\cdot, t)\}_{t \geq 0}$  is a normal family on  $B^n$ . We prove that if  $f = f(\cdot, 0)$  is an extreme point (respectively a support point) of  $S_A^0(B^n)$ , then  $e^{-tA}f(\cdot, t)$  is an extreme point of  $S_A^0(B^n)$  for  $t \geq 0$  (respectively a support point of  $S_A^0(B^n)$  for  $t \geq 0$ ). These results generalize to higher dimensions related results due to Pell and Kirwan. We also consider extremal problems related to bounded mappings in  $S_A^0(B^n)$ .

概要 In this talk, we prove that every origin-preserving automorphism of normal quasi-circular domains is linear.

**16:00~17:00 特別講演**

宮 地 秀 樹 (阪 大 理) Teichmüller 空間の幾何学の Thurston 理論

Hideki Miyachi (Osaka Univ.) Thurston theory on the geometry of Teichmüller space

**概要** I will talk on the “Thurston theory” on the extremal length geometry on Teichmüller space. Indeed, I will give a development on the Teichmüller geometry via the intersection number. Especially, I will explain a relation between the Gromov product with respect to the Teichmüller distance and the intersection number on the space of measured foliations. I will also deal with the rigidity at infinity of the isometries on Teichmüller space.

## 3月16日(日) 第VIII会場

**9:30~10:45**

- 14 濱 野 佐 知 子 (福島大人間発達文化) 半完全正則微分のなす空間の再生核の多変数的変動 ..... 15  
 Sachiko Hamano (Fukushima Univ.) Variation of reproducing kernels for the spaces of holomorphic semiexact differentials

**概要** We study the reproducing kernel for the Hilbert space of all holomorphic semiexact differentials on an open Riemann surface. We show the property of variation of the reproducing kernels with complex parameter under pseudoconvexity.

- 15 鍋 島 克 輔 (徳 島 大 総 合) パラメータ付き局所コホモロジーを利用した対数的ベクトル場の計算に  
 田 島 慎 一 (筑波大数理物質) ついて ..... 15  
 Katsusuke Nabeshima Parametric local cohomology and logarithmic vector fields  
 (Univ. of Tokushima)  
 Shinichi Tajima (Univ. of Tsukuba)

**概要** We have developed a new framework to study logarithmic vector fields along a hypersurface with an isolated singular point. The key of this approach is the concept of a polar variety. By using parametric local cohomology, we have derived an algorithmic method to compute logarithmic vector fields with parameters.

- 16 林 本 厚 志 (長 野 工 高 専)\* 一般化された擬楕円体に対する gap 定理 ..... 15  
 Atsushi Hayashimoto Gap theorem for generalized pseudoellipsoids  
 (Nagano Nat. Coll. of Tech.)

**概要** We show a gap theorem for generalized pseudoellipsoids. It is a generalization of a gap theorem for balls by Faran et al. and for pseudoellipsoids by Ebenfelt–Son.

- 17 足立真訓 (名大多元数理) Levi 平坦面の囲む領域における Diederich–Fornaess 指数の局所的な表示  
公式 ..... 10  
Masanori Adachi (Nagoya Univ.) A local formula for the Diederich–Fornaess exponent on domains bounded  
by Levi-flat real hypersurfaces

概要 To understand geometry of Levi-flat real hypersurfaces in complex manifolds, we have two viewpoints: one is from pseudoconvexity of their complements and the other is from dynamics of their foliations. We connect two approaches by quantifying Brunella’s correspondence between Takeuchi 1-convexity of their complements and positivity of their normal bundles; we will report a local formula for the Diederich–Fornaess exponents of their boundary distances in terms of certain curvatures of the induced hermitian metrics on their normal bundles.

- 18 小池貴之 (東大数理)\* On minimal singular metrics of certain class of line bundles whose section ring is not finitely generated ..... 10  
Takayuki Koike (Univ. of Tokyo) On minimal singular metrics of certain class of line bundles whose section ring is not finitely generated

概要 We show the existence of continuous Hermitian metrics with semi-positive curvatures on Zariski’s example of a line bundle defined over the blow-up of  $\mathbb{P}^2$  at some twelve points which is nef, big, not semi-ample, and whose section ring is not finitely generated. We generalize this result to the higher dimensional case when the base locus  $D$  of a line bundle is a smooth hypersurface with a holomorphic tubular neighborhood. More precisely, we write down a minimal singular metric of the line bundle around  $D$  by only using some special minimal singular metrics of some  $\mathbb{R}$ -line bundles over  $D$  in such a situation.

#### 11:00~12:00 特別講演

- 阿部 誠 (広島大理) 複素空間の有理型凸性と Stein 性  
Makoto Abe (Hiroshima Univ.) Meromorphic convexity and Steinness for complex spaces

概要 We discuss meromorphic convexity and Steinness for complex spaces, especially meromorphic approximation properties and characterizations of Steinness for domains in a Stein space.



# 函数方程式論

3月15日(土) 第V会場

9:00~12:00

- 1 片方 江 (一関工高専) Configurations of equilibrium points in complex differential equations and the Euler–Jacobi formula ..... 10  
 Koh Katagata Configurations of equilibrium points in complex differential equations  
 (Ichinoseki Nat. Coll. of Tech.) and the Euler–Jacobi formula

概要 In this talk, we study the qualitative theory of first order differential equations consisting of the iteration of complex quadratic rational functions and we focus on the configuration, namely location and stability, of simple equilibrium points which correspond to periodic points of the quadratic rational functions. Our main tools are properties of Julia sets of the quadratic rational functions and the Euler-Jacobi formula.

- 2 泉 英 明 (千葉工大情報) Translative mean に付随する関数方程式の解析解 ..... 10  
 J. Matkowski  
 (Univ. of Zielona Góra)  
 Hideaki Izumi (Chiba Inst. of Tech.) Analytic solutions of functional equations associated to translative means  
 Janusz Matkowski  
 (Univ. of Zielona Góra)

概要 We show the existence of analytic solutions to the functional equation associated with translation-invariant means.

- 3 赤 岩 香 苗 (京 大 情 報) 商差法の漸化式に関する漸近的な振る舞いについて ..... 12  
 岩 崎 雅 史 (京都府大生命環境)  
 近 藤 弘 一 (同志社大理工)  
 Kanae Akaiwa (Kyoto Univ.) On the asymptotic behavior in the recurrence relation of the quotient-  
 Masashi Iwasaki (Kyoto Pref. Univ.) difference method  
 Koichi Kondo (Doshisha Univ.)

概要 The quotient-difference (qd) method proposed by Rutishauser in 1954 is known as one of the most important algorithms for computing eigenvalues of a tridiagonal matrix in numerical linear algebra. A solution to the recurrence relation appearing in the qd method can be explicitly expressed by a combination of the Hankel determinants. On the basis of it, the asymptotic analysis of the qd recurrence relation has been already completed in the case where a tridiagonal matrix has no multiple eigenvalues, while it has been not enough in the others. In this talk, we clarify the asymptotic behavior of the determinant solution to the qd recurrence relation in the latter case through reconsidering the formal power series in the Hankel determinants.

- 4 高 橋 甫 宗 (近畿大総合理工) On the WKB theoretic structure of a Schrödinger operator with a Stokes curve of loop type ..... 12  
 Toshinori Takahashi (Kinki Univ.) On the WKB theoretic structure of a Schrödinger operator with a Stokes curve of loop type

概要 A WKB theoretic transformation that brings a Schrödinger equation to the Weber equation near two simple turning points is well-known. In this talk I present a transformation theory to the Bessel equation in a neighborhood of the Stokes curve of loop type and explain some parts of the proof based on the transformation to the Weber equation.

- 5 反 田 美 香 (近畿大総合理工) 超幾何微分方程式における alien derivative ..... 12  
 Mika Tanda (Kinki Univ.) Alien derivatives for the Gauss hypergeometric differential equation

概要 We compute alien derivatives of a WKB solution to the Gauss hypergeometric differential equation with a large parameter. To compute them, we use the singularity structure of the Borel transform of a Voros coefficient of the Gauss equation. The alien derivatives describe parametric Stokes phenomena for the WKB solution.

- 6 後 藤 良 彰 (北 大 理) Monodromy representation of Lauricella's hypergeometric function  $F_C$  ..... 12  
 Yoshiaki Goto (Hokkaido Univ.) Monodromy representation of Lauricella's hypergeometric function  $F_C$

概要 To study the monodromy representation of a system of hypergeometric differential equations, we investigate variation of twisted cycles (integral regions) along loops in the complement of the singular locus. We determine the monodromy representation of Lauricella's hypergeometric function  $F_C$ , by using the twisted homology groups associated to an integral representation of Euler type. In this talk, I would like to explain how the monodromy representation of  $F_C$  is expressed.

- 7 齋 藤 誠 慈 (同志社大理工) 周期的常微分方程式および周期的差分方程式の一樣漸近有界性について ..... 12  
 Seiji Saito (Doshisha Univ.) On uniformly asymptotic boundedness of periodic difference equations

概要 In this talk we introduce definitions of uniformly asymptotic boundedness for ordinary differential equations and difference equations and show theorems on equivalence conditions for ultimate boundedness of solutions to the equations. Moreover we discuss the globally uniformly asymptotic stability of the equilibrium point for the modified Nicholson–Bailey model.

- 8 江 夏 洋 一 (東 大 数 理) 感染症モデルを含む遅延微分方程式系における平衡解の漸近安定性について ..... 12  
 Yoichi Enatsu (Univ. of Tokyo) Asymptotic stability of equilibria of compartmental epidemic models with delays

概要 Stability analysis on mathematical models for population dynamics has played a significant role for prediction of eventual disease transmission in a host population and maintenance of species. In particular, construction methods of **Lyapunov function(al)** have been considered as an important approach in order to obtain global stability of endemic steady states of epidemiological models with **delays**. In this talk, we establish threshold dynamics for compartmental epidemic models by means of Lyapunov functionals based on the LaSalle's invariance principle and its applications. Furthermore, we offer an example that the endemic equilibrium is destabilized due to a **Hopf bifurcation** when the incidence rate is given by a class of non-monotone functions.

- 9 杉 江 実 郎 (島根大総合理工) 減衰線形振動子の一樣漸近安定性に対する離散的条件 ..... 12  
 鬼 塚 政 一 (岡山理大理) Discrete condition for uniform asymptotic stability of damped linear oscillators  
 Jitsuro Sugie (Shimane Univ.)  
 Masakazu Onitsuka (Okayama Univ. of Sci.)

概要 The equations considered in this talk is  $x'' + h(t)x' + \omega^2 x = 0$ , where the prime denotes  $d/dt$ , the damping coefficient  $h(t)$  is continuous and nonnegative for  $t \geq 0$ , and the restoring coefficient  $\omega$  is positive. Our result shows that under the assumption that  $h(t)$  is integrally positive, if a certain infinite series obtained from  $h(t)$  diverges uniformly, then the equilibrium  $(x(t), x'(t)) \equiv (0, 0)$  is uniformly asymptotically stable.

- 10 柴田 徹 太 郎 (広 島 大 工) S-shaped bifurcation curve for semilinear two-parameter problems ..... 12  
 Tetsutaro Shibata (Hiroshima Univ.) S-shaped bifurcation curve for semilinear two-parameter problems

概要 We consider the nonlinear eigenvalue problem with two-parameters, which was introduced by Crandall and Rabinowitz in 1973 as the typical model which develops S-shaped bifurcation curve  $\lambda = \lambda_\epsilon(\alpha)$ . We establish the asymptotic formulas for  $\lambda = \lambda_\epsilon(\alpha)$  as  $\alpha \rightarrow 0$ ,  $\alpha_{1,\epsilon}$ ,  $\alpha_{2,\epsilon}$ ,  $\beta_\epsilon$  when  $0 < \epsilon \ll 1$ , where  $\alpha_{1,\epsilon}$  and  $\alpha_{2,\epsilon}$  are two turning points of  $\lambda_\epsilon(\alpha)$ , and  $\beta_\epsilon$  is the unique positive solution to the algebraic equation associated with our problem.

- 11 梶 木 屋 龍 治 (佐 賀 大 理 工) 一般化された Hénon 方程式の 3 つの正値解の存在 ..... 12  
 Ryuji Kajikiya (Saga Univ.) Existence of three positive solutions for the generalized Hénon equation

概要 We study the one-dimensional generalized Hénon equation under the Dirichlet boundary condition and prove the existence of at least three positive solutions without the assumption of evenness of the coefficient function.

- 12 西本勝之 (デカルト出版)\* The solutions to the homogeneous Bessel equations by means of the  
N-fractional calculus (The calculus in the 21 th century) (Again) ..... 6  
Katsuyuki Nishimoto The solutions to the homogeneous Bessel equations by means of the  
(Descartes Press Co.) N-fractional calculus (The calculus in the 21 th century) (Again)

概要 In this article, the solutions to the homogeneous Bessel equations are discussed again without the omitting of the additional arbitrary constants of the integration, which is omitted in the previous our article. Some one of them is shown as follows, for example.

$$\begin{aligned}\varphi_{[1](K,M)} &= z^\nu e^{iz} \{e^K (e^{-i2z} \cdot z^{-(\nu+1/2)})_{\nu-1/2} + M\} (\text{fractional differintegrated form}) \\ &= e^K (-i2)^{\nu-1/2} z^{-1/2} e^{-iz} {}_2F_0(1/2 - \nu, 1/2 + \nu; i/2z) + M z^\nu e^{iz}, (|i/2z| < 1)\end{aligned}$$

where  $K$  and  $M$  are the additional arbitrary constants of the integrations, and  ${}_pF_q(\cdots)$  is the generalized Gauss hypergeometric functions.

- 13 西本勝之 (デカルト出版)\* The solutions to the nonhomogeneous Bessel equations by means of the  
N-fractional calculus operator ..... 6  
Katsuyuki Nishimoto The solutions to the nonhomogeneous Bessel equations by means of the  
(Descartes Press Co.) N-fractional calculus operator

概要 In this article, the solutions to the nonhomogeneous Bessel equations

$$\varphi_2 \cdot z^2 + \varphi_1 \cdot z + \varphi \cdot (z^2 - \nu^2) = f, (z \neq 0)$$

$$(\varphi_\alpha = d^\alpha \varphi / dz^\alpha \text{ for } \alpha > 0, \varphi_0 = \varphi = \varphi(z), f = f(z) \neq 0)$$

are discussed by means of the N-fractional calculus operator, omitting the additional arbitrary constants of the integration. To the equations above we have a following particular solution for example.

$$\varphi = \varphi_{[1]}^* = z^\nu e^{iz} (G \cdot H)_{\nu-1/2} (\text{fractional differintegrated form})$$

where

$$G = G(z, \nu, i) = (g \cdot z^{\nu+1/2} e^{i2z})_{-1}, (i = \sqrt{-1}), H = H(z, \nu, i) = z^{-(\nu+1/2)} e^{-i2z}$$

and

$$g = g(f, z, \nu, i) = (f \cdot z^{-(\nu+1)} e^{-iz})_{-(\nu+1/2)} \cdot z^{-1}$$

#### 14:15~16:30

- 14 一ノ瀬 弥 (信州大理) Schrödinger 方程式と Dirac 方程式の解の、パラメーターに関する連続性  
と微分可能性 ..... 12  
Wataru Ichinose (Shinshu Univ.) The continuity and the differentiability of solutions on parameters to  
the Schrödinger equations and the Dirac equations

概要 The initial problem of the Schrödinger equations and the Dirac equations are studied with electromagnetic potentials depending on parameters.

It is proved that if electromagnetic potentials are continuous with respect to parameters, so are the solutions and if electromagnetic potentials are differentiable with respect to parameters, so are the solutions.

- 15 一ノ瀬 弥 (信州大理) Dirac 方程式に対する Feynman 経路積分の構成について ..... 12  
 Wataru Ichinose (Shinshu Univ.) On the construction of the Feynman path integral for the Dirac equation

概要 The Feynman path integral is a very useful method to study the quantum method and in particular the quantum field theory. The mathematical rigorousness of the Feynman path integral for the Schroedinger equations has been given. On the other hand, it is well known (c.f. the Feynman–Hibbs book) that there is no simple way of expressing the Feynman path integral for the Dirac equations in the physical theory. In this talk the simple and rigorous expression of the Feynman path integral for the Dirac equations is given by means of the phase space path integral.

- 16 望月 清 (首都大・中大理工) 2次元外部領域における磁場付き Schrödinger 作用素に対する一様リゾル  
 中澤 秀夫 (日本医大) ベント評価 ..... 12  
 Kiyoshi Mochizuki Uniform resolvent estimates for magnetic Schrödinger operators in 2D  
 (Tokyo Metro. Univ.\* / Chuo Univ.) exterior domain  
 Hideo Nakazawa  
 (Nippon Medical School)

概要 We consider the magnetic Schrödinger operator in exterior domain  $\Omega \subset R^2$  with star-shaped boundary with respect to the origin. Under suitable decay and smallness conditions on the magnetic field and external potential, the uniform resolvent estimates are proved. The results are then used to obtain smoothing properties for corresponding evolution equations.

- 17 廣澤 史彦 (山口大理) On second order weakly hyperbolic equations and the ultradifferentiable  
 石田 晴久 (電通大) classes ..... 12  
 Fumihiko Hirosawa (Yamaguchi Univ.) On second order weakly hyperbolic equations and the ultradifferentiable  
 Haruhisa Ishida classes  
 (Univ. of Electro-Comm.)

概要 We consider second order weakly hyperbolic equations with time dependent coefficients in the ultradifferentiable classes. Our main purpose is to clarify the relation between the classes of the functions to be well-posed and the following properties of the coefficients: the order of degeneration, stabilization to a monotonic function and their smoothness in the ultradifferentiable classes.

- 18 佐野 めぐみ (阪市大理) A mean value property for polycaloric functions ..... 12  
 Megumi Sano (Osaka City Univ.) A mean value property for polycaloric functions

概要 It is well known that the caloric functions possess the mean value property. In this talk, we prove a generalization of the mean value property for caloric functions on one space dimension. We introduce the notion of polycaloric functions and prove a mean value property for polycaloric functions.

- 19 坂 田 繁 洋 (首都大東京理工) Poisson 方程式の解の最大点と体の心臓 ..... 12  
 Shigehiro Sakata (Tokyo Metro. Univ.) Maximizers of the solution of Poisson's equation and the heart of a body

概要 We investigate the shape of the graph of Newton's potential. It is well-known that Newton's potential satisfies Poisson's equation. In particular, we investigate the uniqueness of a maximum point of Newton's potential. Using geometric argument with the moving plane method, we define the heart of a body and give a sufficient condition for the uniqueness.

- 20 岡 本 葵 (京 大 理) 空間 1 次元 Chern–Simons–Dirac 方程式の臨界空間および超臨界空間に  
 町 原 秀 二 (埼 玉 大 教 育) おける適切性 ..... 12  
 Mamoru Okamoto (Kyoto Univ.) Well-posedness for the one dimensional Chern–Simons–Dirac system in  
 Shuji Machihara (Saitama Univ.) critical and supercritical regularity spaces

概要 We consider well-posedness of the Cauchy problem for the Chern–Simons–Dirac system in one spatial dimension. Bournaveas, Candy, and Machihara proved that local in time well-posedness in  $H^s(\mathbb{R}) \times H^r(\mathbb{R})$  with  $-1/2 < r \leq s \leq r+1$ . In this talk, we show well-posedness in  $H^s(\mathbb{R}) \times H^r(\mathbb{R})$  with  $(0 \leq s < 1/2$  and  $r = -1/2)$  or  $(s = 0$  and  $-1 \leq r \leq -1/2)$  without the special condition of initial data, in which the flow map fails to be locally uniformly continuous. For the proof, we extract the worst part of nonlinearity and handle separately.

- 21 平 山 浩 之 (名大多元数理) Well-posedness for a system of quadratic derivative nonlinear Schrödinger  
 equations on torus at the scaling critical regularity ..... 10  
 Hiroyuki Hirayama (Nagoya Univ.) Well-posedness for a system of quadratic derivative nonlinear Schrödinger  
 equations on torus at the scaling critical regularity

概要 In this talk, we prove the local well-posedness of the Cauchy problem of a system of quadratic derivative nonlinear Schrödinger equations with periodic initial data at the scaling critical regularity when  $d \geq 5$  and the coefficients of Laplacian in the system satisfy some condition. The same result for the nonperiodic case was obtained by us. But the same argument as the nonperiodic case cannot be used on the several parts of the proof for the periodic case because the admissible pairs of the Strichartz estimate for the periodic case are less than the nonperiodic case. To overcome this difficulty, we show the new bilinear estimate and use it instead of the Strichartz estimate.

- 22 加 藤 勲 (名大多元数理) Global well-posedness of Zakharov system at the critical space in four  
 津 川 光 太 郎 (名大多元数理) and more spatial dimensions ..... 10  
 Isao Kato (Nagoya Univ.) Global well-posedness of Zakharov system at the critical space in four  
 Kotaro Tsugawa (Nagoya Univ.) and more spatial dimensions

概要 We consider the Cauchy problem of the Zakharov system, which describes the Langmuir turbulence in a plasma. According to Ginibre, Tsutsumi and Velo, the critical values of  $(k, l)$  is  $((d-3)/2, (d-4)/2)$ .  $(k, l)$  represents the regularity of initial datum for Schrödinger equation and wave equation. We prove small data global well-posedness at the critical space in four and more spatial dimensions by using  $U^2, V^2$  type Bourgain space. We note that we cannot get crucial bilinear estimate for the nonlinearity of Schrödinger equation only to apply  $U^2, V^2$  spaces. The space-time function space  $L_t^2 L_x^{2d/(d-2)}$  which has Strichartz admissible pair, plays an important role in the bilinear estimate.

- 23 朴 成 勇 (東 北 大 理)\* Local well-posedness and blow-up result for weakly dissipative Camassa–Holm equation ..... 12  
 小 川 卓 克 (東 北 大 理)  
 Sungyong Park (Tohoku Univ.) Local well-posedness and blow-up result for weakly dissipative Camassa–Takayoshi Ogawa (Tohoku Univ.) Holm equation

概要 In this talk, we consider the Cauchy problem of the weakly dissipative Camassa–Holm equation. More precisely, we show that the weakly dissipative Camassa–Holm equation is locally well-posed in the critical Besov space and blows-up in the sense of the Sobolev space.

#### 16:45～17:45 特別講演

- 水 谷 治 哉 (学 習 院 大 理) 変数係数シュレディンガー方程式に対するストリッカーズ評価について  
 Haruya Mizutani (Gakushuin Univ.) On Strichartz estimates for Schrödinger equations with variable coefficients

概要 We discuss recent progress concerning Strichartz estimates for Schrödinger equations, which measure the size and dispersion of solutions for the Cauchy problem. Such estimates are powerful tools for studying nonlinear Schrödinger equations, and hence have been extensively studied both for Schrödinger equations with potentials and Schrödinger equations with variable coefficients. In this talk, after recalling basic notions of Strichartz estimates, we give a unified approach to a combination of these two kinds of cases. In particular we discuss (1) local-in-time Strichartz estimates for long-range metrics combined with growing electromagnetic potentials; (2) global-in-time Strichartz estimates for long-range metrics.

3月16日(日) 第V会場

#### 9:00～12:00

- 24 藤 原 和 将 (早 大 理 工) 半相対論的連立方程式系の時間大域可解性 ..... 12  
 町 原 秀 二 (埼 玉 大 教 育)  
 小 澤 徹 (早 大 理 工)  
 Kazumasa Fujiwara (Waseda Univ.) Global well-posedness of the Cauchy problem for a semirelativistic system  
 Shuji Machihara (Saitama Univ.)  
 Tohru Ozawa (Waseda Univ.)

概要 We study the global well-posedness of the Cauchy problem for systems of semirelativistic equations with quadratic nonlinearity. The problem is shown to be globally well-posed in  $H^{1/2}$  by a compactness argument. In our proof, the charge conservation law and the energy conservation law are important. From the conservation laws, we have the uniform boundness and uniform Hölder continuity for an approximation sequence for a solution. Then the weak limit of a subsequence of the approximation sequence is shown to be the solution of the Cauchy problem. Moreover the solution is shown to be continuous in time with values in  $H^{1/2}$  with continuous dependence on the initial data

- 25 星 埜 岳 (早 大 理 工) Analytic solutions to nonlinear Schrödinger equation ..... 12  
 小 澤 徹 (早 大 理 工)  
 Gaku Hoshino (Waseda Univ.) Analytic solutions to nonlinear Schrödinger equation  
 Tohru Ozawa (Waseda Univ.)

概要 We prove the global existence of analytic solutions to nonlinear Schrödinger equation with quintic nonlinearity in  $n$  space dimensions for sufficiently small Cauchy data with exponential decay.

- 26 山 崎 陽 平 (京 大 理) \* 非線形 Schrödinger 方程式の横方向不安定性と分岐点の安定性 ..... 10  
 Yohei Yamazaki (Kyoto Univ.) Transverse instability of a nonlinear Schrödinger equation and the stability of a bifurcation point

概要 We consider the transverse instability for a nonlinear Schrödinger equation on  $\mathbb{R} \times \mathbb{T}_L$ , where  $2\pi L$  is a period of the torus  $\mathbb{T}_L$ . There exists a critical period  $L_*$  such that the line standing wave is stable for  $L < L_*$  and the line standing wave is unstable for  $L > L_*$ . In this talk, we farther consider the stability for the boundary  $L = L_*$  between the stability and the instability for line standing waves of the nonlinear Schrödinger equation.

- 27 瓜 屋 航 太 (東 北 大 理) \* 2 次の非線形 Schrödinger 方程式系に対する終値問題 ..... 10  
 小 川 卓 克 (東 北 大 理)  
 Kota Uriya (Tohoku Univ.) Final state problem for a system of quadratic nonlinear Schrödinger  
 Takayoshi Ogawa (Tohoku Univ.) equations

概要 We consider the final state problem for a system of quadratic nonlinear Schrödinger equations with mass resonance condition. It is known that quadratic nonlinearities are critical between existence and non-existence of asymptotic free solutions. We construct a new modification to show the existence of a solution to the problem. More precisely, we show the behavior of solution which describes that mass of the first component of solution decay to 0 and the second component of solution obtains total mass of the solution.

- 28 鈴 木 敏 行 (東 京 理 大 理) Blowup for Hartree type equations with inverse-square potentials .... 12  
 Toshiyuki Suzuki (Tokyo Univ. of Sci.) Blowup for Hartree type equations with inverse-square potentials

概要 We consider the blowup in finite time for Hartree type equations (nonlinear Schrödinger equations of nonlocal nonlinearity) with inverse-square potentials  $(\mathbf{HE})_a$  by applying the Glassey method. Key of his method is virial identity. But the identity for  $(\mathbf{HE})_a$  has not proved in consequence of the strongly singular potential  $a|x|^{-2}$ . Thus we give a strict proof of the identity.



- 29 成 亥 隆 恭 (京 大 理) 非線形 Klein–Gordon 方程式における複素数値解の分類について ..... 10  
 Takahisa Inui (Kyoto Univ.) Classification of complex valued solutions for the nonlinear Klein–Gordon equation

概要 Ibrahim, Masmoudi and Nakanishi classified scattering solutions and blow-up ones for subcritical Klein–Gordon equation with real valued data. We extend this result to complex valued data. In detail, we classify them for cubic Klein–Gordon equation in 3-dimension with complex valued data. Since blow-up result was obtained by Ohta and Todorova, we prove scattering result. This proof is based on the method of Ibrahim, Masmoudi and Nakanishi.

- 30 若 杉 勇 太 (阪 大 理)\* On diffusion phenomena for the linear wave equation with space-dependent damping ..... 10  
 Yuta Wakasugi (Osaka Univ.) On diffusion phenomena for the linear wave equation with space-dependent damping

概要 We consider the linear wave equation with space-dependent damping. Todorova and Yordanov (2009) introduced a weighted energy method and showed that the decay rate of the energy of solutions coincides with that of the corresponding heat equation. In this talk, we give an extension of their result to estimates of higher order derivatives and show that the asymptotic profile of the solution is given by a solution of the corresponding heat equation.

- 31 小 野 公 輔 (徳 島 大 総 合)\* Global existence and decay estimates for mildly degenerate Kirchhoff type dissipative wave equations to the Cauchy problem ..... 12  
 Kosuke Ono (Univ. of Tokushima) Global existence and decay estimates for mildly degenerate Kirchhoff type dissipative wave equations to the Cauchy problem

概要 We consider the global existence and decay estimates of solutions to the Cauchy problem for mildly degenerate dissipative wave equations of Kirchhoff type. In the case that the exponent of the nonlocal term is small, we derive the decay rates of the solutions by using several identities.

- 32 渡 辺 朋 成 (広 島 大 理)\* 時空間に非一様な消散項を持つ非線形波動方程式の大域解の存在と時間減衰評価 ..... 12  
 Tomonari Watanabe (Hiroshima Univ.) Global existence and decay estimates for the nonlinear wave equations with space-time dependent dissipative term

概要 We study global existence and decay estimates for nonlinear wave equations with space-time dependent dissipative term in an exterior domain. We assume the linear dissipative effect may vanish in a compact space region. Moreover the nonlinearity to be quasilinear and need not have divergence form. For getting the higher order energies, we introduce an argument using the rescaling. The method useful to control derivatives of the dissipative coefficient.

- 33 津田谷 公利 \* On the asymptotic behavior of solutions of the wave equation of Hartree type ..... 12  
 P. Karageorgis (Trinity Coll.)  
 Kimitoshi Tsutaya On the asymptotic behavior of solutions of the wave equation of Hartree type  
 Paschalis Karageorgis (Trinity Coll.)

概要 We study the scattering problem of the wave equation of a Hartree type with small initial data with slow decay. We give the sharp conditions needed to define the scattering operator by showing scattering and no scattering results.

- 34 廣澤 史彦 (山口 大理) Some classes of non-analytic functions for the global solvability of Kirchhoff equation ..... 12  
 Fumihiko Hirose (Yamaguchi Univ.) Some classes of non-analytic functions for the global solvability of Kirchhoff equation

概要 We consider the global solvability to the Cauchy problem of Kirchhoff equation in some special classes of non-analytic functions, which are extensions of Manfrin's class in [Manfrin (JDE2005)] and [Hirose (JDE2006)].

- 35 林 仲夫 (阪 大理) \* Nonexistence of scattering states for the generalized Ostrovsky–Hunter equation ..... 10  
 Nakao Hayashi (Osaka Univ.) Nonexistence of scattering states for the generalized Ostrovsky–Hunter equation

概要 We consider the Cauchy problem for the generalized Ostrovsky–Hunter equation. Time decay estimate of solutions to linear problem was studied. However it is not known that the estimate is sharp or not. We give a sufficient condition which implies the time decay estimate is sharp and as an application of the result we prove non existence of the usual scattering states of the generalized Ostrovsky–Hunter equation.

### 13:15～14:15 2013年度(第12回)解析学賞受賞特別講演

- 利根川 吉廣 (北 大理) 平均曲率流の正則性理論について  
 Yoshihiro Tonegawa (Hokkaido Univ.) On the regularity theory for mean curvature flow

概要 Brakke defined a notion of mean curvature flow valid for non-smooth surfaces. I explain the definition and related existence results as well as our recent partial regularity theorem and  $\varepsilon$ -regularity theorem.

3月17日(月) 第V会場

### 9:00～12:00

- 36 梅田 典晃 (明 大理工) On vanishing at space infinity for semilinear heat equation with absorption ..... 12  
 Noriaki Umeda (Meiji Univ.) On vanishing at space infinity for semilinear heat equation with absorption

概要 We consider a solution of a Cauchy problem for a semilinear heat equation with an absorption. The initial datum of the problem is bounded and its infimum is more than zero. We study the solution which does not vanish in the total space at the vanishing time. It does only at space infinity.

- 37 國谷紀良 (東大数理) 年齢変数を含む非線形偏微分方程式の漸近解析における不変性原理とリアプノフ汎関数の手法について ..... 12  
 Toshikazu Kuniya (Univ. of Tokyo) Invariance principle and Lyapunov functional for the asymptotic analysis of nonlinear partial differential equations with age variable

概要 In this talk, we are concerned with the asymptotic analysis of some biological models expressed as nonlinear partial differential equations including age variable. In the analysis, the invariance principle combined with some Lyapunov functionals plays an important role. In particular, the necessity of showing the relative compactness of orbits in an infinite dimensional Banach space occurs. We will focus on some recent results obtained by using the invariance principle.

- 38 川中子正 (東工大理工) The Hopf bifurcation theorem for semilinear equations ..... 12  
 Tadashi Kawanago (Tokyo Tech) The Hopf bifurcation theorem for semilinear equations

概要 We established the Hopf bifurcation theorem for abstract semilinear equations, which gives a criterion for the Hopf bifurcation to occur. We may consider it as an improvement of the theorem established by Crandall and Rabinowitz at 1977. Our theorem can be proved by the codimension- $m$  bifurcation theorem established recently by the author.

- 39 石田祥子 (東京理大理) 非凸領域における準線形退化放物・放物型 Keller–Segel 系の解の有界性  
 関清隆 (東京理大理) ..... 12  
 横田智巳 (東京理大理)  
 Sachiko Ishida (Tokyo Univ. of Sci.) Boundedness of solutions to quasilinear degenerate Keller–Segel systems  
 Kiyotaka Seki (Tokyo Univ. of Sci.) of parabolic-parabolic type on non-convex domains  
 Tomomi Yokota (Tokyo Univ. of Sci.)

概要 This talk is concerned with quasilinear degenerate Keller–Segel systems of parabolic-parabolic type on non-convex bounded domains. The uniform-in-time boundedness of weak solutions is established under the subcritical condition. The result is a degenerate diffusion and non-convex domain version of the recent result by Tao and Winkler (2012).

- 40 藤江健太郎 (東京理大理) 増殖項とシグナル依存型感応性関数をもつ放物・楕円型 Keller–Segel 系  
 横田智巳 (東京理大理) の解の有界性 ..... 12  
 Kentarou Fujie (Tokyo Univ. of Sci.) Boundedness of solutions to parabolic-elliptic Keller–Segel systems with  
 Tomomi Yokota (Tokyo Univ. of Sci.) growth term and signal-dependent sensitivity function

概要 This talk deals with parabolic-elliptic chemotaxis systems with the sensitivity function  $\chi(v)$  and the growth term  $f(u)$  under homogeneous Neumann boundary conditions in a smooth bounded domain. Here it is assumed that  $0 < \chi(v) \leq \frac{\chi_0}{v^k}$  ( $k \geq 1$ ,  $\chi_0 > 0$ ) and  $\lambda_1 - \mu_1 u \leq f(u) \leq \lambda_2 - \mu_2 u$  ( $\lambda_1, \lambda_2, \mu_1, \mu_2 > 0$ ). It is shown that if  $\chi_0$  is sufficiently small, then the system has a unique global-in-time classical solution that is uniformly bounded.

- 41 隠居良行(九大数理)    Uniqueness theorem on weak solutions to the Keller–Segel system of  
 川上竜樹(阪府大工)    degenerate and singular types ..... 12  
 杉山由恵(九大数理)  
 Yoshiyuki Kagei (Kyushu Univ.)    Uniqueness theorem on weak solutions to the Keller–Segel system of  
 Tatsuki Kawakami (Osaka Pref. Univ.)    degenerate and singular types  
 Yoshie Sugiyama (Kyushu Univ.)

概要 The uniqueness of weak solutions to the Keller–Segel systems of degenerate and singular types is proved in the class of Hölder continuous functions. Hölder continuity is expected to be an optimal regularity for weak solutions of the degenerate Keller–Segel systems under consideration. Our proof for the uniqueness result is based on the vanishing viscosity duality method.

- 42 杉山由恵(九大数理)    Global solutions to a chemotaxis system with non-diffusive memory ·· 12  
 筒井容平  
 (早大基幹理工・阪市大数学研)  
 J. J. L. Velázquez ( Univ. Bonn )  
 Yoshie Sugiyama (Kyushu Univ.)    Global solutions to a chemotaxis system with non-diffusive memory  
 Youhei Tsutsui  
 (Waseda Univ./Osaka City Univ.)  
 Juan J. L. Velázquez (Univ. Bonn)

概要 In this talk, we give a small data global existence theorem for a chemotaxis system on the whole space. Our system consists of a chemotaxis equation with a logarithmic term and an ordinary equation without diffusion term.

- 43 森田善久(龍谷大理工)    A reaction-diffusion system with mass conservation ..... 10  
 鈴木貴(阪大基礎工)  
 Yoshihisa Morita (Ryukoku Univ.)    A reaction-diffusion system with mass conservation  
 Takashi Suzuki (Osaka Univ.)

概要 We study global-in-time behavior of the solution to a reaction diffusion system with mass conservation proposed in the study of cell polarity. First, we have global-in-time solution with compact orbit and then examine stability and instability of stationary solutions.

- 44 坂口茂(東北大情報)\*    Fast diffusion and geometry of domain ..... 12  
 Shigeru Sakaguchi (Tohoku Univ.)    Fast diffusion and geometry of domain

概要 We consider two fast diffusion equations  $\partial_t u = \operatorname{div}(|\nabla u|^{p-2} \nabla u)$  and  $\partial_t u = \Delta u^m$ , where  $1 < p < 2$  and  $0 < m < 1$ . Let  $\Omega$  be a domain in  $\mathbb{R}^N$  with  $N \geq 2$ , and let  $u = u(x, t)$  be the solution of the initial-boundary value problem over  $\Omega$ , where the initial value equals zero and the boundary value is positive. Choose an open ball  $B$  in  $\Omega$  whose closure intersects  $\partial\Omega$  only at one point. Then, we derive an asymptotic formula for the integral of some positive power of  $u$  over  $B$  for short times in terms of principal curvatures of  $\partial\Omega$  at the point, which tells us about the interaction between fast diffusion and geometry of domain. The Cauchy problem is also dealt with.

- 45 生駒典久 (東北大理)\* Singular perturbation problems for the Kirchhoff type equations with  
 G. M. Figueiredo general nonlinearities ..... 12  
 (Univ. Federal do Pará)  
 J. R. S. Junior  
 (Univ. Federal do Pará)  
 Norihisa Ikoma (Tohoku Univ.) Singular perturbation problems for the Kirchhoff type equations with  
 Giovany M. Figueiredo general nonlinearities  
 (Univ. Federal do Pará)  
 João R. Santos Junior  
 (Univ. Federal do Pará)

概要 This talk is devoted to the study of the Kirchhoff type equations with potential functions and general nonlinearities. We show the existence of a family of positive solutions which concentrates (up to subsequence) around local minimum points of the potential functions.

- 46 生駒典久 (東北大理)\* Eigenvalue problems for fully nonlinear second-order elliptic PDE on  
 石井仁司 (早大教育) balls ..... 12  
 Norihisa Ikoma (Tohoku Univ.) Eigenvalue problems for fully nonlinear second-order elliptic PDE on  
 Hitoshi Ishii (Waseda Univ.) balls

概要 This talk concerns the eigenvalue problems for fully nonlinear second-order elliptic operators on intervals or balls. We prove the existence of sequences of eigenvalues and (radially symmetric) eigenfunctions under various types of boundary conditions. We also show that there is no eigenvalue and (radially symmetric) eigenfunction other than those we find.

- 47 内免大輔 (阪市大理) The critical problem of Kirchhoff type elliptic equations in dimension  
 four ..... 12  
 Daisuke Naimen (Osaka City Univ.) The critical problem of Kirchhoff type elliptic equations in dimension  
 four

概要 We investigate the Kirchhoff type elliptic boundary value problems in dimension four. In particular we consider the critical case and show the existence of solutions of those. Our method is based on the variational method and the concentration compactness argument for the PS sequences.

- 48 原 宇 信 (首都大東京理工) 強い特異性をもつ 1 階の項を伴う楕円型方程式の弱解の正則性評価につ  
 いて ..... 10  
 Takanobu Hara (Tokyo Metro. Univ.) Regularity properties of weak solutions of second order elliptic equations  
 with strongly singular drifts

概要 We consider second order linear elliptic equations  $-\operatorname{div}(A(x)\nabla u)+b(x)\cdot\nabla u=0$  with a strongly singular vector field  $b$ . We prove a subsolution estimate and a weak Harnack inequality for weak supersolutions under certain assumptions on  $b$  which are best possible in some sense.

## 14:15~16:15

- 49 久藤 衡介 (電通大情報理工) Limiting structure of steady-states to the Lotka–Volterra competition  
 辻川 亨 (宮崎大工) model with large diffusion and advection ..... 12  
 Kousuke Kuto Limiting structure of steady-states to the Lotka–Volterra competition  
 (Univ. of Electro-Comm.) model with large diffusion and advection  
 Tohru Tsujikawa (Univ. of Miyazaki)

概要 This talk is concerned with the Neumann problem of a stationary Lotka–Volterra competition model with diffusion and advection. First we introduce a limiting system as diffusion and advection of one of the species tend to infinity. The limiting system can be reduced to a semilinear elliptic equation with nonlocal constraint. Next we obtain the bifurcation structure of nonconstant solutions to the limiting system in the simplified 1D case. This structure involves a simple curve of nonconstant solutions which connects two different singularly perturbed states (boundary layer solutions and internal layer solutions).

- 50 梅津 健一郎 (茨城大教育)\* On  $S$ -shaped and  $CS$ -shaped bifurcation diagrams in population dynam-  
 H. R. Quoirin ics ..... 12  
 (Univ. de Santiago de Chile)  
 Kenichiro Umezū (Ibaraki Univ.) On  $S$ -shaped and  $CS$ -shaped bifurcation diagrams in population dynam-  
 Humberto Ramos Quoirin ics  
 (Univ. de Santiago de Chile)

概要 In this talk we investigate a semilinear elliptic equation with a logistic nonlinearity and an indefinite nonlinear boundary condition, both depending on a parameter  $\lambda$ . Based on variational and bifurcation techniques, our main results establish the existence of *three* nontrivial non-negative solutions for some values of  $\lambda$ , as well as their asymptotic behavior. These results suggest that the positive solution set contains an  $S$ -shaped component in some case, as well as a combination of a  $C$ -shaped and a  $S$ -shaped components in another case.

- 51 宮本 安人 (東大数理) 指数増大の非線形項を持つ Dirichlet 問題の正值球対称解の構造について ..... 12  
 Yasuhito Miyamoto (Univ. of Tokyo) Structure of the positive radial solutions for elliptic equations with exponential growth

概要 Let  $B \subset \mathbb{R}^N$ ,  $N \geq 3$ , be the unit ball. We study the global bifurcation diagram of the solutions of

$$\begin{cases} \Delta u + \lambda f(u) = 0 & \text{in } B, \\ u = 0 & \text{on } \partial B, \\ u > 0 & \text{in } B, \end{cases}$$

where  $f(u) = e^u + g(u)$  and  $g(u)$  is a lower order term. The solution set is a curve  $\mathcal{C}$  parametrized by the  $L^\infty$ -norm of the solution. We show that this problem has the singular solution  $(\lambda^*, u^*)$  and that the curve  $\mathcal{C}$  has infinitely many turning points around  $\lambda^*$  if  $3 \leq N \leq 9$ . We show that under a certain condition on  $g$  the curve  $\mathcal{C}$  has no turning point if  $N \geq 10$ . We also study the Morse index of  $u^*$ .

- 52 足達 慎二 (静岡大工)\* 渡辺 達也 (京都産大理)  
 Shinji Adachi (Shizuoka Univ.)  
 Tatsuya Watanabe  
 (Kyoto Sangyo Univ.)
- Uniqueness and non-degeneracy of positive radial solutions for quasilinear elliptic equations with exponential nonlinearity ..... 12
- Uniqueness and non-degeneracy of positive radial solutions for quasilinear elliptic equations with exponential nonlinearity

概要 We are concerned with the uniqueness and non-degeneracy result of positive solutions for a class of quasilinear elliptic equation with exponential nonlinearity. We convert a quasilinear elliptic equation into a semilinear one and study precise correspondences between two equations. We show the uniqueness and the non-degeneracy of positive solutions by analyzing the converted semilinear problem.

- 53 F. Gladiali  
 (Univ. degli Studi di Sassari)  
 M. Grossi  
 (Univ. di Roma “La Sapienza”)  
 大塚 浩史 (金沢大理工)  
 Francesca Gladiali  
 (Univ. degli Studi di Sassari)  
 Massimo Grossi  
 (Univ. di Roma “La Sapienza”)  
 Hiroshi Ohtsuka (Kanazawa Univ.)
- On the number of peaks of the eigenfunctions of the linearized Gel’fand problem ..... 12
- On the number of peaks of the eigenfunctions of the linearized Gel’fand problem

概要 We derive a second order estimate for the first  $m$  eigenvalues of the linearized Gel’fand problem associated to solutions which blow-up at  $m$  points. This allows us to determine, in some suitable situations, some qualitative properties of the first  $m$  eigenfunctions as the number of points of concentration.

- 54 塩路 直樹 (横浜国大工) 渡辺 宏太郎 (防衛大情報工)  
 Naoki Sioji (Yokohama Nat. Univ.)  
 Kohtaro Watanabe  
 (Nat. Defense Acad. of Japan)
- 楕円型方程式  $\Delta u + \nabla \rho \nabla u / \rho - gu + hu^p = 0$  の正值球対称解の一意性と  
 その非退化性について ..... 12
- Uniqueness of positive radial solutions of  $\Delta u + \nabla \rho \nabla u / \rho - gu + hu^p = 0$   
 and its nondegeneracy

概要 We study the uniqueness of positive radial solutions of  $\Delta u + \nabla \rho \nabla u / \rho - gu + hu^p = 0$ . We also study its nondegeneracy in an appropriate function space.

- 55 高橋 太 (阪市大理)  
 Futoshi Takahashi (Osaka City Univ.)
- Extremal solutions to Liouville–Gelfand type elliptic problems with nonlinear Neumann boundary conditions ..... 12
- Extremal solutions to Liouville–Gelfand type elliptic problems with nonlinear Neumann boundary conditions

概要 Consider the Liouville–Gelfand type problems with nonlinear Neumann boundary conditions on a smooth bounded domain, with a smooth, strictly positive, convex, increasing nonlinearity which is superlinear at  $+\infty$ . In this talk, after introducing a suitable notion of weak solutions, we prove several properties of so-called extremal solutions of the problem.

- 56 高橋 太 (阪 市 大 理) Continuum spectrum for the linearized extremal eigenvalue problem with boundary reactions ..... 12
- Futoshi Takahashi (Osaka City Univ.) Continuum spectrum for the linearized extremal eigenvalue problem with boundary reactions

**概要** We consider the Liouville–Gelfand type elliptic problem with nonlinear Neumann boundary conditions, the nonlinearity of which is a smooth, strictly positive, convex, increasing function, and is superlinear at infinity. We study the spectral properties of the so-called extremal weak solution and show a phenomenon of weak continuum spectrum for the corresponding linearized eigenvalue problem.

### 16:30~17:30 特別講演

- 立 川 篤 (東京理大理工)  $p(x)$ -調和写像の正則性について
- Atsushi Tachikawa (Tokyo Univ. of Sci.) On the regularity of  $p(x)$ -harmonic maps

**概要** In this talk we discuss the regularity of minimizers for  $p(x)$ -growth functionals with special structures. Let  $\Omega \subset \mathbb{R}^m$  ( $m \geq 2$ ) be a bounded open set, For maps  $u : \Omega \rightarrow \mathbb{R}^n$  we consider the  $p(x)$ -energy functional defined as

$$\mathcal{E}(u; \Omega) := \int_{\Omega} \left( g^{\alpha\beta}(x) h_{ij}(u) D_{\alpha} u^i(x) D_{\beta} u^j(x) \right)^{p(x)/2} dx,$$

where  $(g^{\alpha\beta}(x))$  and  $(h_{ij}(u))$  are symmetric positive definite matrices whose entries are Hölder continuous functions defined on  $\Omega$  and  $\mathbb{R}^n$  respectively, and  $p(x)$  a Hölder continuous function on  $\Omega$  with  $p(x) \geq 2$ . We assume that  $(g^{\alpha\beta}(x))$  and  $(h_{ij}(u))$  satisfy, for some positive constants  $\lambda_g \leq \Lambda_g$  and  $\lambda_h \leq \Lambda_h$ ,

$$\begin{aligned} \lambda_g |\xi|^2 &\leq g^{\alpha\beta}(x) \xi_{\alpha} \xi_{\beta} \leq \Lambda_g |\xi|^2, \quad \forall (x, \xi) \in \Omega \times \mathbb{R}^m, \\ \lambda_h |\eta|^2 &\leq h_{ij}(u) \eta^i \eta^j \leq \Lambda_h |\eta|^2 \quad \forall (u, \eta) \in \mathbb{R}^n \times \mathbb{R}^n. \end{aligned}$$

For a local minimizer  $u$ , we show that  $u \in C^{1,\alpha}(\Omega_0)$  for some  $\alpha \in (0, 1)$  and an open set  $\Omega_0 \subset \Omega$  with  $\dim^{\mathcal{H}}(\Omega \setminus \Omega_0) < m - \inf p(x)$ , where  $\dim^{\mathcal{H}}$  stands for the Hausdorff dimension. If  $p(x)$  is Lipschitz continuous and  $u$  is bounded, then we can improve the estimate for the Hausdorff dimension of the singular set of  $u$ . Moreover, if  $h_{ij}(u)$  satisfies the so-called *one sided condition*;

$$-\frac{1}{2} u^k \frac{\partial h_{ij}(u)}{\partial u^k} \xi^i \xi^j \leq \lambda_h^* |\xi|^2 \quad \forall (u, \xi) \in \mathbb{R}^n \times \mathbb{R}^n \quad \text{for } \lambda_h^* < \lambda_h,$$

then  $u$  enjoys full interior regularity.



3月18日(火) 第V会場

## 9:00~12:00

- 57 中塚智之(名大多元数理)\* On uniqueness of symmetric Navier–Stokes flows around a body in the plane ..... 12  
 Tomoyuki Nakatsuka (Nagoya Univ.) On uniqueness of symmetric Navier–Stokes flows around a body in the plane

**概要** In this talk, we consider the uniqueness of symmetric weak solutions to the stationary Navier–Stokes equation in a two-dimensional exterior domain  $\Omega$ . It is known that, under suitable symmetry condition on the domain and the data, the problem admits at least one symmetric weak solution tending to zero at infinity. Given two symmetric weak solutions  $u$  and  $v$ , we show that if  $u$  satisfies the energy inequality  $\|\nabla u\|_{L^2(\Omega)}^2 \leq (f, u)$  and  $\sup_{x \in \Omega} (|x| + 1)|v(x)|$  is sufficiently small, then  $u = v$ . The proof relies upon a density property for the solenoidal vector field and the Hardy inequality for symmetric functions.

- 58 牛越恵理佳(玉川大工)\* New approach to the Hadamard variational formula for the Green function of the Stokes equations ..... 10  
 Erika Ushikoshi (Tamagawa Univ.) New approach to the Hadamard variational formula for the Green function of the Stokes equations

**概要** We consider the Hadamard variational formula for the Green function of the Stokes equations on the bounded domain with the smooth boundary. Under the perturbation with preserving its volume and keeping its topological type, we establish a more refined proof of its formula of the Green function not only for the first variation but also the second variation for both velocity and pressure. Our method gives a new systematic proof of the Hadamard variational formula, which enables us to deal with the higher derivatives with respect to the perturbation of domains.

- 59 上野大樹(慶大理工) On the thin film approximation for the flow of a viscous incompressible fluid down an inclined plane ..... 12  
 白石曉識  
 井口達雄(慶大理工)  
 Hiroki Ueno (Keio Univ.) On the thin film approximation for the flow of a viscous incompressible fluid down an inclined plane  
 Akinori Shiraishi  
 Tatsuo Iguchi (Keio Univ.)

**概要** We consider a two-dimensional motion of liquid film of a viscous and incompressible fluid flowing down an inclined plane under the influence of the gravity and the surface tension on the surface. The problem is mathematically formulated as a free boundary problem for the Navier–Stokes equations. Our purpose is to give a mathematically rigorous justification of a thin film approximation by establishing the error estimate between the solution of the Navier–Stokes equations and that of approximate equations. In this talk, we report that under smallness assumptions on the Reynolds number, the angle of inclination, and the initial fluctuation the solution of the initial value problem for the Navier–Stokes equations satisfies uniform estimates with respect to a thin film parameter.

- 60 近藤 信太郎 (明大 MIMS) Almost-periodic solution of linearized Hasegawa–Wakatani equations with vanishing resistivity ..... 12  
 Shintaro Kondo (Meiji Univ.) Almost-periodic solution of linearized Hasegawa–Wakatani equations with vanishing resistivity

概要 We consider the zero-resistivity limit for linearized Hasegawa–Wakatani equations in a cylindrical domain when the initial data are Stepanov-almost-periodic to the axial direction. Hasegawa–Wakatani equations describes the resistive drift wave turbulence. We prove that the Stepanov-almost-periodic solution of linearized Hasegawa–Wakatani equations converges to that of linearized Hasegawa–Mima like equation as the resistivity tends to zero.

- 61 鈴木 政尋 (東工大情報理工)\* 多成分プラズマの運動を記述するモデル方程式の定常解について ..... 12  
 Masahiro Suzuki (Tokyo Tech) Stationary solutions to the equation for a multicomponent plasma

概要 In this talk, we study a boundary layer, called a sheath, which occurs on the surface of materials with which a multicomponent plasma contacts. For the sheath formation, the generalized Bohm criterion demands that the ions enter the sheath region with a high velocity. The motion of the multicomponent plasma is governed by the Euler–Poisson equations. The sheath is mathematically understood as the stationary solution to the equations. We show the unique existence and the asymptotic stability of the stationary solution under the the generalized Bohm criterion.

- 62 大縄 将史 (早大非線形PDE研) 輻射気体モデルにおける強い不連続進行波の安定性 ..... 12  
 Masashi Ohnawa (Waseda Univ.) Asymptotic stability of strong traveling waves for a radiating gas model

概要 We study asymptotic behaviors of perturbations around sufficiently strong shock waves to the Hamer model system of a radiating gas. We obtain global solutions for small initial perturbations and show that they converge uniformly to traveling waves. As a corollary, all super critical shock waves are asymptotically stable to small odd initial perturbations. This work extends previous results by the author on the stability of subcritical shock waves and instability of a critical shock wave and gives a new characterization of the patterns of traveling waves obtained using phase plane analysis.

- 63 吉田 夏海 (阪大情報) Global asymptotic stability of a multiwave pattern for the scalar conservation law with degenerate flux and viscosity ..... 12  
 Natsumi Yoshida (Osaka Univ.) Global asymptotic stability of a multiwave pattern for the scalar conservation law with degenerate flux and viscosity

概要 We study the asymptotic behavior of solutions toward a multiwave pattern (rarefaction wave and viscous contact wave) of the Cauchy problem for one-dimensional viscous conservation law where the far field states are prescribed.

Especially, we deal with the case when the flux function is convex or concave but linearly degenerate on some interval, and also the viscosity is a nonlinearly degenerate one.

The most important thing for the proof is how to obtain the a priori energy estimates.

- 64 沖田 匡 聡 (九大数理) 圧縮性 Navier–Stokes 方程式の臨界空間における解の減衰評価 ..... 12  
 Masatoshi Okita (Kyushu Univ.) Optimal decay rate for strong solutions in critical spaces to the compressible Navier–Stokes equations

概要 We are concerned with the convergence rates of the global strong solution to motionless state with constant density for the compressible Navier–Stokes equations in the whole space  $\mathbb{R}^n$  for  $n \geq 2$ . It is proved that the perturbations decay in critical spaces, if the initial perturbations of density and velocity are small in  $\dot{B}_{2,1}^{\frac{n}{2}}(\mathbb{R}^n) \cap \dot{B}_{1,\infty}^0(\mathbb{R}^n)$  and  $\dot{B}_{2,1}^{\frac{n}{2}-1}(\mathbb{R}^n) \cap \dot{B}_{1,\infty}^0(\mathbb{R}^n)$ , respectively.

- 65 古場 一 (早大理工)\* ブシネスク型方程式のエネルギー解の安定性解析 ..... 12  
 Hajime Koba (Waseda Univ.) On stability of Boussinesq type system

概要 In this talk, we consider the asymptotic stability of the spatial inhomogeneous Navier–Stokes–Boussinesq system with general nonlinearity including both power nonlinear terms and convective terms. We apply an energy inequality and some assumptions to derive the stability of energy solutions of our system.

- 66 岩 渕 司 (中大理工)\* Global solutions for the Burgers equation in the Besov spaces and the large time behavior ..... 12  
 Tsukasa Iwabuchi (Chuo Univ.) Global solutions for the Burgers equation in the Besov spaces and the large time behavior

概要 We consider the Cauchy problem for the critical Burgers equation in the Besov spaces. We show that the unique global solutions exist for small initial data in  $\dot{B}_{\infty,1}^0(\mathbb{R}^n)$ . We also consider the large time behavior of the solutions for initial data in  $L^1(\mathbb{R}^n) \cap \dot{B}_{\infty,1}^0(\mathbb{R}^n)$  to show that the solutions behave like the Poisson kernel.

- 67 岡 部 考 宏 (弘前大教育)\* Space-time asymptotics of the two dimensional Navier–Stokes flow in the whole plane ..... 10  
 Takahiro Okabe (Hirotsaki Univ.) Space-time asymptotics of the two dimensional Navier–Stokes flow in the whole plane

概要 We consider the space-time behavior of the two dimensional Navier–Stokes flow. Carpio, Fujigaki–Miyakawa, and Miyakawa–Schonbek showed the asymptotic expansion and the energy decay of the Navier–Stokes flow under the moment condition on initial data. In this paper, without any moment condition on the initial data, we derive the asymptotic expansion. Moreover, for the critical decay rate, the necessary and sufficient condition on initial data as in Miyakawa–Schonbek is concerned.

## 14:15~15:15

- 68 久保隆徹 (筑波大数理物質) On the  $\mathcal{R}$ -boundedness of solution operators for the compressible-compressible two phase problem ..... 10  
 柴田良弘 (早大理工)  
 曾我幸平 (CNRS-ENS Lyon)  
 Takayuki Kubo (Univ. of Tsukuba) On the  $\mathcal{R}$ -boundedness of solution operators for the compressible-compressible two phase problem  
 Yoshihiro Shibata (Waseda Univ.)  
 Kohei Soga (CNRS-ENS Lyon)

概要 In this talk, we will consider the model problem for the two phase problem in cases of compressible-compressible fluid flows without surface tension. In order to prove the local in time existence of this problem, the generation of analytic semigroup for linearized problem and its maximal  $L_p - L_q$  regularity are needed in our method. The key step of our method is to prove the existence of  $\mathcal{R}$ -bounded solution operator to the generalized resolvent problem corresponding the linearized problem. In this talk, we will report  $\mathcal{R}$ -boundedness for solution operator.

- 69 柴田良弘 (早大理工)  $\mathcal{R}$ -bounded solution operators for the Stokes equations with free boundary condition and its application, Incompressible case ..... 10  
 Yoshihiro Shibata (Waseda Univ.)  $\mathcal{R}$ -bounded solution operators for the Stokes equations with free boundary condition and its application, Incompressible case

概要 I would like to talk about the existence of  $\mathcal{R}$  bounded solution operators for the Stokes equations with free boundary condition, which combined with Weis' operator valued Fourier multiplier theorem furnishes the generation of analytic semigroup and maximal  $L_p - L_q$  regularity of the time dependent problem. Moreover, as an application, I will talk about a local in time unique existence theorem for some free boundary problem of the Navier-Stokes equations in a uniform  $W_q^{2-1/q}$  domain in  $\mathbb{R}^N$  without surface tension.

- 70 柴田良弘 (早大理工)  $\mathcal{R}$ -bounded solution operators for the Stokes equations with free boundary condition and its application, Compressible case ..... 10  
 ホンベロウローレンツ  
 (TU Darmstadt)  
 榎本裕子  
 (芝浦工大システム理工)  
 Yoshihiro Shibata (Waseda Univ.)  $\mathcal{R}$ -bounded solution operators for the Stokes equations with free boundary condition and its application, Compressible case  
 Lorenz von Below (TU Darmstadt)  
 Yuko Enomoto (Shibaura Inst. of Tech.)

概要 I would like to talk about the existence  $\mathcal{R}$ -bounded solution operators for the Stokes equations with free boundary condition arising from some free boundary problem of compressible barotropic viscous fluid flows without surface tension in a uniform  $W_q^{2-1/q}$  domain. As an application, we have the generation of analytic semigroup and maximal  $L_p - L_q$  regularity theorem for the time dependent problem. And also, we have a local in time unique existence theorem in any uniform  $W_q^{2-1/q}$  domain and a global in time unique existence theorem for some initial data closed to trivial state in a bounded domain.

- 71 柴田良弘 (早大理工) On a global in time unique existence theorem for some free boundary problem of the Navier–Stokes equations without surface tension . . . . . 10  
 Yoshihiro Shibata (Waseda Univ.) On a global in time unique existence theorem for some free boundary problem of the Navier–Stokes equations without surface tension

概要 I would like to talk about a global in time unique existence theorem for some free boundary problem of the Navier–Stokes equations without surface tension in a bounded domain in  $\mathbb{R}^N$ , whose boundary is a hypersurface of  $W_q^{2-1/q}$  class initially. The result was obtained by Prof. Solonnikov: Math. USSR Izvestiya 31 (1988), 381–405. Since he proved maximal regularity only for local in time, his argument is rather complicated to show the prolongation of local in time solutions. But, I proved some exponential decay estimate of solutions to the linearized problem, and my prolongation argument relies on this decay theorem, which makes the argument rather simpler than Prof. Solonnikov’s one.

- 72 村田美帆 (早大理工) 圧縮性粘性流体に対する時間局所解の一意存在性 . . . . . 10  
 柴田良弘 (早大理工)  
 Miho Murata (Waseda Univ.) Local in time unique existence of solutions to compressible viscous fluid  
 Yoshihiro Shibata (Waseda Univ.) flow

概要 In this talk, we consider the motion of viscous compressible barotropic fluid in a uniform  $W_q^{3-1/q}$  domain  $\Omega \subset \mathbb{R}^N$  ( $2 \leq N < q < \infty$ ) with boundary  $\Gamma$ . Our purpose is a local in time unique existence of solutions in the  $L_p$  in time and  $L_q$  in space framework with  $2 < p < \infty$ ,  $N < q < \infty$ .

### 15:30~16:30 特別講演

- 和田健志 (熊本大工) 平滑化効果と Maxwell–Schrödinger 方程式の大域的適切性  
 Takeshi Wada (Kumamoto Univ.) Smoothing effects and global well-posedness of Maxwell–Schrödinger equations

概要 In this talk, we consider the Maxwell–Schrödinger equations in  $R^{1+n}$ . This system describes the time evolution of the interaction between a charged particle and electro-magnetic field generated by the motion of this particle. We mainly aim at showing the well-posedness of this system in low regularity Sobolev spaces. To do this, we need some smoothing estimates of Kato type for magnetic Schrödinger equations with low regularity potentials and Koch–Tzvetkov type estimates, which are some modification of Strichartz type estimates. Applying such estimates together with modified Strichartz estimates for wave equations, we prove global well-posedness of Maxwell–Schrödinger equations for  $n \leq 3$ .

# 実 函 数 論

3月17日(月) 第Ⅲ会場

9:00~12:05

- 1 富澤佑季乃 (中大理工) Bregman 距離による非 Lipschitz な非線形写像 ..... 15  
Yukino Tomizawa (Chuo Univ.) Non-Lipschitzian mappings with respect to the Bregman distance

**概要** In this lecture, we introduce new extension of asymptotically quasi-nonexpansive mappings in the intermediate sense with respect to the Bregman distance. The extension mapping is not Lipschitz continuous. We can have the following results: In certain conditions, the set of fixed points of the extension mapping is closed and convex. Moreover, we have a strong convergence theorem of the shrinking projection method for finding a fixed point of the extension mapping in real reflexive Banach spaces. These results are extension of results of asymptotically quasi-nonexpansive mappings in the intermediate sense with respect to particular distance-like functions.

- 2 青山耕治 (千葉大法経) 逆強単調写像に関する変分不等式問題の求解法 ..... 15  
Koji Aoyama (Chiba Univ.) Approximations to solutions of the variational inequality problem for inverse-strongly-monotone mappings

**概要** In this talk, we consider the variational inequality problem for a countable family of inverse-strongly-monotone mappings in a Hilbert space. Then we provide an iterative algorithm to find a solution of this problem. Moreover, we also establish strong convergence theorems for the variational inequality problem for an inverse-strongly-monotone mapping and the zero point problem for a maximal monotone operator.

- 3 田中亮太郎 (新潟大自然) 2次元 Tingley 問題への幾何的アプローチについて ..... 15  
Ryotaro Tanaka (Niigata Univ.) A geometric approach to two-dimensional Tingley's problem

**概要** Tingley's problem, also known as the isometric extension problem, has been studied by many mathematicians since 1987. In this talk, we propose a new geometric approach to two-dimensional Tingley's problem.

- 4 三谷健一 (岡山県立大情報工) 2次元 Lorentz 数列空間及びその双対空間の James 定数 ..... 15  
斎藤吉助 (新潟大理)  
田中亮太郎 (新潟大自然)  
Kenichi Mitani (Okayama Pref. Univ.) James constant of two dimensional Lorentz sequence space and its dual  
Kichi-Suke Saito (Niigata Univ.)  
Ryotaro Tanaka (Niigata Univ.)

**概要** The James constant of a Banach space was introduced by Gao and Lau. In this talk we present some recent results on James constant of 2-dimensional Lorentz sequence space and its dual space.

- 5 水口 洋 康 (新潟大 自然) Several geometric constants and the extreme points of the unit ball  $\cdots$  15  
 Hiroyasu Mizuguchi (Niigata Univ.) Several geometric constants and the extreme points of the unit ball

概要 Mitani and Saito introduced and studied a geometric constant  $\gamma_{X,\psi}$  of a Banach space  $X$ , by using the notion of  $\psi$ -ditect sum. For  $t \in [0, 1]$ , the constant  $\gamma_{X,\psi}(t)$  is defined as a supremum taken over all elements in the unit sphere of  $X$ . We obtain that, for a Banach space with a predual Banach space, the supremum can be taken over all extreme points of the unit ball.

- 6 渡辺 俊 一 (新潟大 自然) Fixed point theorem for set-valued Kannan mappings with a vector-valued distance  $\cdots$  15  
 豊田 昌 史 (玉川大 工) Toshikazu Watanabe (Niigata Univ.) Fixed point theorem for set-valued Kannan mappings with a vector-valued distance  
 Masashi Toyoda (Tamagawa Univ.)

概要 In this talk, we consider fixed point theorems for set-valued Kannan mappings using  $v$ -distances.

- 7 池田 敏 春 (九工大 工) On von Neumann–Jordan and James constants for absolute norms on  $\mathbb{R}^2$   $\cdots$  15  
 加藤 幹 雄 (信州大 工) Toshiharu Ikeda (Kyushu Inst. of Tech.) On von Neumann–Jordan and James constants for absolute norms on  $\mathbb{R}^2$   
 Mikio Kato (Shinshu Univ.)

概要 Let  $\|\cdot\|_\psi$  be the absolute norm on  $\mathbb{R}^2$  corresponding to a convex function  $\psi$  on  $[0, 1]$  and  $C_{\text{NJ}}(\|\cdot\|_\psi)$  its von Neumann–Jordan constant. It is known that  $\max\{M_1^2, M_2^2\} \leq C_{\text{NJ}}(\|\cdot\|_\psi) \leq M_1^2 M_2^2$ , where  $M_1 = \max_{0 \leq t \leq 1} \psi(t)/\psi_2(t)$ ,  $M_2 = \max_{0 \leq t \leq 1} \psi_2(t)/\psi(t)$  and  $\psi_2$  is the corresponding function to the  $\ell_2$ -norm. In this talk, we shall discuss equality-attainedness of the above inequalities. In particular we shall present a characterization for the the right side inequality to attain equality. Similar results for the James constant will be presented.

- 8 厚 芝 幸 子 (山梨大 教育人間) Strong convergence theorems for nonlinear mappings by iterative schemes  $\cdots$  15  
 Sachiko Atsushiba Strong convergence theorems for nonlinear mappings by iterative schemes  
 (Univ. of Yamanashi)

概要 In this talk, we study common attractive points and prove convergence theorems for nonlinear mappings. We also prove strong convergence theorems for nonexpansive semigroups by some iterative schemes. Using these results, we obtain new and well-known convergence theorems.

- 9 M. Ali Khan (Johns Hopkins Univ.) Weak sequential convergence in  $L^1(\mu, X)$  and an exact version of Fatou's lemma ..... 15  
 佐 柄 信 純 (法 政 大 経 済) lemma ..... 15  
 M. Ali Khan (Johns Hopkins Univ.) Weak sequential convergence in  $L^1(\mu, X)$  and an exact version of Fatou's lemma  
 Nobusumi Sagara (Hosei Univ.) lemma

概要 The class of non-atomic finite measure spaces with the saturation property, as developed in Maharam (1942) and Hoover–Keisler (1984), is characterized by the Fatou (and Lebesgue) property of a well-dominated sequence of multifunctions taking values in a Banach space. With multifunctions reduced to functions, this Fatou characterization also extends to a variant of the closure property found in optimal control theory. The results are developed through a considered overview of the relevant literature on the exact and approximate Fatou lemma phrased in terms of Bochner integration.

- 10 宮 崎 洋 一 (日 大 歯)\* ソボレフ空間の複素補間の入門的考察 ..... 15  
 Yoichi Miyazaki (Nihon Univ.) Introduction to complex interpolation between Sobolev spaces

概要 We give a simple proof of the theorem on complex interpolation between  $L_p$ -based Sobolev spaces of integral order, using Muramatu's first integral formula. Muramatu proved the theorem for Sobolev spaces of fractional order by Muramatu's second integral formula. He characterized a Sobolev function in terms of its regularization and reduced the problem to finding the complex interpolation between weighted  $L_p(L_2)$  spaces. Compared to Muramatu's method, ours is straightforward.

- 11 山 崎 洋 平 実例で探る広義積分と極限の交換 —優関数条件に背を向けて— ..... 15  
 Yōhei Yamasaki The commutation of limit and singular integral, avoiding the dominating functions

概要 This talk give examples to treat the commutation of limit and singular integral of primitive functions in plural variables. The result is frequently commutative, but in some cases it fails.

#### 14:15~16:25

- 12 川 崎 敏 治 (日 大 工) Criteria for the C-integral ..... 15  
 中 西 シ ヅ (阪 府 大)  
 鈴 木 一 郎 (日 本 文 化 大)  
 Toshiharu Kawasaki (Nihon Univ.) Criteria for the C-integral  
 Shizu Nakanishi (Osaka Pref. Univ.)  
 Ichiro Suzuki (Nihon Bunka Univ.)

概要 We will give new criteria for the C-integral.



- 13 山本隆範 (北海学園大工)\* Majorization of singular integral operators with Cauchy kernel on  $L^2$  ..... 15  
 Takanori Yamamoto Majorization of singular integral operators with Cauchy kernel on  $L^2$   
 (Hokkai-Gakuen Univ.)

概要 Let  $a, b, c$  and  $d$  be functions in  $L^2 = L^2(\mathbb{T}, d\theta/2\pi)$ , where  $\mathbb{T}$  denotes the unit circle. Let  $\mathcal{P}$  denote the set of all trigonometric polynomials. Suppose the singular integral operators  $A$  and  $B$  are defined by  $A = aP + bQ$  and  $B = cP + dQ$  on  $\mathcal{P}$ , where  $P$  is an analytic projection and  $Q = I - P$  is a co-analytic projection. In this paper, we use the Helson–Szegő type set  $(HS)(r)$  to establish the condition of  $a, b, c$  and  $d$  satisfying  $\|Af\|_2 \geq \|Bf\|_2$  for all  $f$  in  $\mathcal{P}$ . If  $a, b, c$  and  $d$  are bounded measurable functions, then  $A$  and  $B$  are bounded operators, and this is equivalent to that  $B$  is majorized by  $A$  on  $L^2$ , i.e.,  $A^*A \geq B^*B$  on  $L^2$ . Applications are then presented for the majorization of singular integral operators on weighted  $L^2$  spaces.

- 14 本田あおい (九工大情報工)\* Shepp 空間の linear quasi-metric ..... 15  
 岡崎悦明 (九工大情報工)  
 佐藤坦 (九工大\*)  
 Aoi Honda (Kyushu Inst. of Tech.) Linear quasi-metric of the Shepp space  
 Yoshiaki Okazaki  
 (Kyushu Inst. of Tech.)  
 Hiroshi Sato (Kyushu Univ.\*)

概要 The notion of the linear quasi-metric is introduced. If a linear space admits a translation invariant linear quasi-metric, then it becomes a topological linear space. The main interest is the linear topology of the Shepp space which is studied systematically as a linear quasi-metric topology. The linear quasi-metric topologies on the approximation spaces of the Shepp space are also considered.

- 15 J. M. Cunanan (名大多元数理) Inclusion relations between  $L^p$ -Sobolev and Wiener amalgam spaces ··· 15  
 Jayson Mesitas Cunanan Inclusion relations between  $L^p$ -Sobolev and Wiener amalgam spaces  
 (Nagoya Univ.)

概要 We determined optimal inclusion relations between  $L^p$ -Sobolev and Wiener amalgam spaces. As an application we discuss mapping properties of unimodular Fourier operators  $e^{i|D|^\alpha}$  between  $L^p$ -Sobolev and Wiener amalgam spaces.

- 16 貞末 岳 (大阪教育大数学教育) A characterization of BLO martingales ..... 15  
 中井英一 (茨城大理)  
 Gaku Sadasue (Osaka Kyoiku Univ.) A characterization of BLO martingales  
 Eiichi Nakai (Ibaraki Univ.)

概要 We show several properties of BLO martingales. In particular, we give a new characterization of BLO martingales.

- 17 田中 仁 (東大数理) The Fatou property of block spaces ..... 15  
 澤野 嘉宏 (首都大東京理工)  
 Hitoshi Tanaka (Univ. of Tokyo) The Fatou property of block spaces  
 Yoshihiro Sawano (Tokyo Metro. Univ.)

概要 Around thirty years ago, block spaces, which are the predual of Morrey spaces, had been considered. However, it seems that there is no proof that block spaces satisfy the Fatou property. In this talk the Fatou property for block spaces is verified and the predual of block spaces is characterized.

- 18 岡田 正己 (首都大東京理工)\* 2次元近似サンプリング定理に向けて —不規則配置の場合— ..... 15  
 Masami Okada (Tokyo Metro. Univ.) Toward two-dimensional approximate sampling theorem —scattered data—

概要 We have investigated a kind of generalization of the Shannon's sampling theorem, i.e.  $\mathbb{R}, \mathbb{Z}$  are replaced respectively by  $\mathbb{R}^2, X$ , where  $X$  consists of (irregularly) scattered countably infinite points of  $\mathbb{R}^2$ . We shall show that under suitable conditions, a robust interpolation formula is provided by means of a linear combination of a suitable positive definite functions. Moreover, an error estimate by the Besov norm will be given whose proof is reduced to the case of the regular lattice.

- 19 齋藤 洋樹 (首都大東京理工) Boundedness of the Kakeya maximal operators on the variable Lebesgue  
 田中 仁 (東大数理) spaces ..... 15  
 Hiroki Saito (Tokyo Metro. Univ.) Boundedness of the Kakeya maximal operators on the variable Lebesgue  
 Hitoshi Tanaka (Univ. of Tokyo) spaces

概要 In this talk, we shall verify the Kakeya (Nikodym) maximal operator  $K_N$  is bounded on the variable Lebesgue space  $L^{p(\cdot)}(\mathbb{R}^2)$  whenever the exponent function  $p(\cdot)$  satisfies log-Hölder continuity conditions.

**16:45~17:45 特別講演**

出 来 光 夫 (東京電機大工) 変動指数をもつ種々の関数空間の実解析的研究

Mitsuo Izuki (Tokyo Denki Univ.) A real analytic study of various function spaces with variable exponent

**概要** The aim of this talk is to introduce some recent results on function spaces with variable exponent in terms of real analysis. The main result consists of wavelet application to variable function spaces and generalization of the BMO norm using variable exponent.

If we use wavelets with proper decay and smoothness, then we can characterize and get bases of various function spaces. Recently approximation theory with bases given by wavelets is applied and marked in many areas, for example image analysis, signal analysis, statistical estimation and numerical analysis of partial differential equations. We discuss wavelet characterization and construction of bases of function spaces with variable exponent. Additionally we state modular inequalities arising from wavelets on Lebesgue spaces with variable exponent.

The BMO space is known as the dual space of the Hardy space  $H^1$  and one of the most important function spaces on real analysis. It is also known that the BMO norm is generalized to the scale of the  $L^p$  norm ( $1 \leq p < \infty$ ) by virtue of an argument with the John–Nirenberg inequality. We can generalize the BMO norm in terms of variable exponent satisfying suitable conditions. The study on catching the BMO norm in the context of general Banach function spaces has recently been progressed. The equivalent expressions of the BMO norm will be applied to get boundedness of commutators involving BMO functions on various function spaces and to new characterizations of function spaces.

## 3月18日(火) 第Ⅲ会場

**9:00~12:20**

- 20 村 瀬 勇 介 (名城大理工) 準劣微分作用素によって生成される楕円型変分不等式と仮似変分不等式  
久 保 雅 弘 (名工大工) について ..... 15  
Yusuke Murase (Meijo Univ.) Existence of solutions for variational and quasi-variational inequalities  
Masahiro Kubo (Nagoya Inst. of Tech.) generated by quasi-subdifferential operators

**概要** In this talk, we show you the existence of solutions for nonlinear variational inequalities and quasi-variational inequalities that are generated by quasi-subdifferential operators. Quasi-variational inequality is a variational inequality whose constraint set depends upon unknown functions self.

- 21 内 田 俊 (早大理工) The solvability of double-diffusive convection system in general domains  
大 谷 光 春 (早大理工) ..... 15  
Shun Uchida (Waseda Univ.) The solvability of double-diffusive convection system in general domains  
Mitsuharu Ôtani (Waseda Univ.)

**概要** In this talk, we discuss the solvability of the initial boundary value problem of a system which describes double-diffusive convection in some porous medium in general space domains. In our previous work, the solvability of the system in bounded domains was considered and the existence of a unique global solution is proved, where we relied on an abstract result based on the Schauder's fixed point argument, which can not work for the general (unbounded) domains. Instead of the previous argument, we here apply Banach contraction mapping principle.

- 22 都 築 寛 (東京理大理) Solvability of  $p$ -Laplace heat equations with constraints coupled with  
 深 尾 武 史 (京都教育大教育) Navier-Stokes equations in 3D domains ..... 15  
 横 田 智 巳 (東京理大理)  
Yutaka Tsuzuki (Tokyo Univ. of Sci.) Solvability of  $p$ -Laplace heat equations with constraints coupled with  
Takeshi Fukao (Kyoto Univ. of Edu.) Navier-Stokes equations in 3D domains  
Tomomi Yokota (Tokyo Univ. of Sci.)

概要 This talk is concerned with the system of nonlinear heat equations with constraints coupled with Navier-Stokes equations. The existence and uniqueness of solutions have been already proved for several types of the system in 2-dimensional domains. This talk gives the existence result in 3-dimensional domains, where the diffusion term on heat equations is the  $p$ -Laplacian with  $p \geq 3$ .

- 23 吉井健太郎 (東京理大理) Non-normal form of abstract evolution equations of hyperbolic type .. 15  
 岡 沢 登 (東京理大理)  
Kentarou Yoshii (Tokyo Univ. of Sci.) Non-normal form of abstract evolution equations of hyperbolic type  
Noboru Okazawa (Tokyo Univ. of Sci.)

概要 We consider the abstract Cauchy problem for linear evolution equations of the form

$$\begin{cases} B(t)(d/dt)u(t) + A(t)u(t) = f(t), & t \in I, \\ u(0) = u_0. \end{cases}$$

Here  $\{A(t); t \in I\}$  and  $\{B(t); t \in I\}$  are families of closed linear operators in a complex Hilbert space.

- 24 小 山 哲 也 (広島工大工) On a regularity theorem for non-smooth domains ..... 15  
Tetsuya Koyama On a regularity theorem for non-smooth domains  
 (Hiroshima Inst. of Tech.)

概要 A regularity theorem for second order elliptic equations on domains which are convex and have polygon boundary is discussed.

- 25 小 川 卓 克 (東 北 大 理)\* 熱方程式の初期値問題の  $L^1$  最大正則性の最適性について ..... 15  
 清 水 扇 丈 (静岡大理)  
Takayoshi Ogawa (Tohoku Univ.) On optimality of end-point  $L^1$  maximal regularity for the Cauchy prob-  
Senjo Shimizu (Shizuoka Univ.) lem of the heat equation

概要 We prove  $L^1$  maximal regularity of the Cauchy problem in the Besov space  $\dot{B}_{p,1}^0(\mathbb{R}^n)$  with  $1 \leq p \leq \infty$ . The estimate obtained here is not available by abstract theory in the class of UMD since the end-point Besov space is included. Besides, we discuss the optimality of maximal regularity in  $L^1$ .

- 26 白川 健 (千葉大教育) 結晶粒界現象に対する凝固による界面拡散を考慮した数学モデル ..... 15  
 渡邊 紘 (サレジオ工高専)  
 山崎 教昭 (神奈川大工)  
 Ken Shirakawa (Chiba Univ.) Mathematical models of grain boundary motions with solidifications  
 Hiroshi Watanabe (Salesian Polytech.)  
 Noriaki Yamazaki (Kanagawa Univ.)

概要 In this talk, a mathematical model of the grain boundary motion involving solidification effect is considered. The major theme of this study is to ensure qualitative properties for the mathematical model from the theoretical viewpoint in mathematics. As a part of this theme, we here focus on an analytical approach based on the time-discretization, and conclude the existence theorem of our mathematical model. Furthermore, we will mention about the problems in future with some supplemental comments.

- 27 山崎 教昭 (神奈川大工) Non-autonomous phase-field models of grain boundary motion with constraint ..... 15  
 Noriaki Yamazaki (Kanagawa Univ.) Non-autonomous phase-field models of grain boundary motion with constraint

概要 We study a grain boundary motion model of Kobayashi–Warren–Carter type, which is a phase-field system of a nonlinear parabolic partial differential equation and a nonlinear parabolic variational inequality. In this talk we study non-autonomous systems of grain boundary motion. More precisely, we consider the time-dependent mobility function for the mean orientation of the crystalline. Then, we show the existence-uniqueness and large-time behavior of solutions to our non-autonomous systems.

- 28 應和宏樹 (新潟大自然)\*  $n \times n$  双曲型保存則方程式系に対する波面追跡法について ..... 15  
 Hiroki Ohwa (Niigata Univ.) On the wave-front tracking algorithm for  $n \times n$  hyperbolic systems of conservation laws

概要 This talk is concerned with the global existence of solutions to the Cauchy problem for  $n \times n$  hyperbolic systems of conservation laws with initial data having sufficiently small total variation. We show the global existence of solutions by improving the wave-front tracking algorithm.

- 29 登口 大 (早大教育) 乗法的確率項を持つ保存型方程式に対する初期値・境界値問題の一意性 ..... 15  
 小林 和夫 (早大教育)  
 Dai Noboriguchi (Waseda Univ.) Uniqueness for the initial-boundary value problem for conservation laws  
 Kazuo Kobayasi (Waseda Univ.) with a multiplicative noise

概要 We consider the initial-boundary value problem for a randomly forced scalar conservation laws with multiplicative noise on a bounded domain  $D$  in  $\mathbb{R}^d$ :  $du + \operatorname{div}(A(u)) dt = \Phi(u) dW(t)$  in  $(0, T) \times D$ ,  $u(0, \cdot) = u_0(\cdot)$  on  $D$ ,  $u \cong u_b$  on  $(0, T) \times \partial D$ . We give the contraction property for kinetic solutions  $u_1$  and  $u_2$  of the problem associated with data  $(u_{1,0}, u_{1,b})$  and  $(u_{2,0}, u_{2,b})$ , respectively:  $E \int_D |u_1(t) - u_2(t)| dx \leq E \int_D |u_{1,0} - u_{2,0}| dx + ME \int_0^t \int_{\partial D} |u_{1,b}(s) - u_{2,b}(s)| d\sigma(x) ds$ . In particular, uniqueness of kinetic solutions is obtained.

- 30 山崎 洋平 微分を使わない逆写像・陰関数 ..... 15  
 Yōhei Yamasaki Inverse maps and implicit functions without differentiation

概要 The inverse function theorem requires the differentiation. This talk improves the core part of this theorem in the continuity class.

- 31 坂田 繁洋 (首都大東京理工) Riesz ポテンシャルの最大点の一意性と体の心臓 ..... 15  
 Shigehiro Sakata (Tokyo Metro. Univ.) Uniqueness of a maximizer of Riesz potential and the heart of a body

概要 We investigate the uniqueness of a maximum point of the Riesz potential. A maximum point of the Riesz potential defines a center of a body, and the uniqueness has been studied by many geometers. We give a new sufficient condition for the uniqueness.

#### 14:15~15:55

- 32 深尾 武史 (京都教育大教育) Allen–Cahn equation with dynamic boundary conditions and mass constraints ..... 15  
 P. Colli (Pavia Univ.)  
 Takeshi Fukao (Kyoto Univ. of Edu.) Allen–Cahn equation with dynamic boundary conditions and mass constraints  
 Pierluigi Colli (Pavia Univ.)

概要 The Allen–Cahn equation coupled with the dynamic boundary condition was treated by many papers, recently. The new issue of this talk is the setting of the mass constraint which can involve either the solution inside of the domain or its counterpart on the boundary.

- 33 渡邊 紘 (サレジオ工高専) 空間変数に依存する拡散項を持つ強退化放物型方程式 ..... 15  
 Hiroshi Watanabe (Salesian Polytech.) Strongly degenerate parabolic equations with diffusion terms depending on the spatial variable

概要 We consider the initial value problem (CP) for strongly degenerate parabolic equations with diffusion term depending on the spatial variable. Strongly degenerate parabolic equations are regarded as a linear combination of the time-dependent conservation laws (quasilinear hyperbolic equations) and the porous medium type equations (nonlinear degenerate parabolic equations). Thus, this equation has both properties of hyperbolic equation and those of parabolic equations and describes various nonlinear convective diffusion phenomena such as filtration problems, Stefan problems and so on.

In this talk, we employ a new entropy pair and entropy solutions associated with (CP). Our purpose is to prove the uniqueness and existence of new entropy solutions in the space BV.

- 34 山下 洋司 (東京理大理) Existence of solutions to some degenerate parabolic equation associated  
 横田 智巳 (東京理大理) with the  $p$ -Laplacian in the critical case ..... 15  
 Yoji Yamashita (Tokyo Univ. of Sci.) Existence of solutions to some degenerate parabolic equation associated  
 Tomomi Yokota (Tokyo Univ. of Sci.) with the  $p$ -Laplacian in the critical case

概要 This talk is concerned with the initial-boundary value problem for the following degenerate parabolic equation:  $u_t(x, t) - \Delta_p u(x, t) - |u|^{q-2} u(x, t) = f(x, t)$  with initial data  $u_0 \in L^r(\Omega)$ ,  $\Omega \subset \mathbb{R}^N$ . Akagi (2007) established the existence of local (in time) solutions to this problem in the case  $r > N(q-p)/p$ ; however, the critical case  $r = N(q-p)/p$  has been left as an open problem. In this talk, even in the critical case  $r = N(q-p)/p$ , the existence of solutions to the problem is established under a certain restriction on  $u_0$ . The key to our proof is Tartar's inequality, which enables us to derive desired convergences of approximate solutions to the problem from the compactness of the embedding  $W_0^{1,p}(\Omega) \subset L^2(\Omega)$ . Incidentally, any smoothness is not imposed on  $\partial\Omega$  at all while smooth boundary is needed in Akagi's result.

- 35 愛木 豊彦 (日本女大理) Smoluchowski population balance equation modified for hot colloids .. 15  
 O. Krehel (TU Eindhoven)  
 A. Muntean (TU Eindhoven)  
 Toyohiko Aiki (Japan Women's Univ.) Smoluchowski population balance equation modified for hot colloids  
 Oleh Krehel (TU Eindhoven)  
 Adrian Muntean (TU Eindhoven)

概要 In this we consider a system of partial differential equations describing a mass conservation law for colloids in a small part of a porous medium. Here, we treat the Smoluchowski population balance equation as a reaction rate of generation of colloid particles. The aim of this talk is to show modeling process of the system and to establish the existence and uniqueness of a solution to initial boundary value problem for the system. Since some terms of the equations for the balance law are approximated and neglected in this result, it is open problem to improve the result.

- 36 藤江 健太郎 (東京理大理) 癌浸潤現象に関するある数理モデルの時間局所的古典解の存在と一意性  
 伊藤 昭夫 (近畿大工) ..... 15  
 横田 智巳 (東京理大理)  
 Kentarou Fujie (Tokyo Univ. of Sci.) Existence and uniqueness of local-in-time classical solutions to a math-  
 Akio Ito (Kinki Univ.) ematical model on tumor invasion phenomenon  
 Tomomi Yokota (Tokyo Univ. of Sci.)

概要 The present work is concerned with the questions of local existence and uniqueness of solutions to the PDEs-ODE system to model a tumor invasion phenomenon. Using some estimate for  $e^{t\Delta}\nabla\cdot$ , we prove that the system possesses a unique local-in-time classical solution easily.

- 37 加納 理成 (高知大教育) ある癌浸潤モデルにおける可解性について ..... 15  
 Risei Kano (Kochi Univ.) The solvability of the evolution problems for the tumor invasion models

概要 In this talk, we discuss the solvability for weak solutions in the tumor invasion models. We have already showed the existence of solutions using the method of quasi-variational inequalities. But we do not show some propositions of solutions (for example, uniqueness), since its method has great nonlinearity. Then we show the existence of weak solutions for solutions for tumor invasion models.

**16:15～17:15 特別講演**

熊崎 耕太 (苫小牧工高専)\* コンクリート中性化現象を表す数理モデルについて

Kota Kumazaki

A mathematical model for concrete carbonation phenomenon

(Tomakomai Nat. Coll. of Tech.)

**概要** Concrete is made of sand, gravel, cement and water, and is a material which shows alkalinity due to calcium hydrate which is the main ingredient of cement. Concrete carbonation is a phenomenon that this alkalinity changes into acidity due to carbon dioxide. This phenomenon is a big serious damage to the concrete buildings so that it is an important problem from the civil engineering point of view. In this talk, we consider a mathematical model for concrete carbonation phenomenon. This phenomenon occurs in the voids inside of concrete with some chemical reaction, the whole concrete carbonates due to the liquid of water generated by this reaction. Therefore, we focus on the moisture and carbon dioxide transport, and consider two models in three dimensional cases. In this talk, we discuss a mathematical model for two transports and its mathematical analysis.



# 函数解析学

3月15日(土) 第II会場

9:30~11:50

- 1 武村 一雄 (日大生産工)\* 重み付き  $d$ -有限正則グラフ上の離散ソボレフ不等式の最良定数 ..... 10  
 Kazuo Takemura (Nihon Univ.) The best constants of discrete Sobolev inequalities on the finite  $d$ -regular weighted graph

概要 Two kinds of discrete Sobolev inequalities, corresponding to a Laplacian matrix on the finite  $d$ -regular weighted graph, are obtained. The best constants are calculated by using a Green matrix of the discrete heat equation and a pseudo Green matrix of the stationary state discrete heat equation.

- 2 鈴木 章斗 (信州大工)\* 周期的にペンダントを付加した  $d$  次元格子のスペクトル ..... 15  
 Akito Suzuki (Shinshu Univ.) Spectra of graphs obtained from the  $d$ -dimensional lattice by periodically adding pendant vertices

概要 We consider a graph obtained by adding pendant vertices to the  $d$ -dimensional lattice. We give a sufficient condition under which the Laplacian on such a graph has a spectral gap.

- 3 山岸 弘幸 (産業技術高専)  $(-1)^M(d/dx)^{2M}$  のディリクレ・ノイマン境界値問題に対応する  $L^p$  ソボレフ不等式の最良定数 ..... 10  
 渡辺 宏太郎 (防衛大)   
 亀高 惟倫 (阪大\*)  
 Hiroyuki Yamagishi The best constant of  $L^p$  Sobolev inequality corresponding to Dirichlet-Neumann boundary value problem  
 (Tokyo Metropolitan Coll. of Indus. Tech.)  
 Kohtaro Watanabe  
 (Nat. Defense Acad. of Japan)  
 Yoshinori Kametaka (Osaka Univ.\*)

概要 For an element of Sobolev space with Dirichlet-Neumann boundary condition, we have obtained the best constant of  $L^p$  Sobolev inequality including  $j$ -th derivative. The best constant is expressed by Bernoulli polynomials.

- 4 山岸 弘幸 (産業技術高専) 糸のたわみ問題と離散ソボレフ不等式の最良定数 ..... 10  
 永井 敦 (日大生産工)  
 亀高 惟倫 (阪大\*)  
 Hiroyuki Yamagishi The best constant of discrete Sobolev inequality corresponding to a bending problem of a string  
 (Tokyo Metropolitan Coll. of Indus. Tech.)  
 Atsushi Nagai (Nihon Univ.)  
 Yoshinori Kametaka (Osaka Univ.\*)

概要 We obtain the best constants of discrete Sobolev inequalities corresponding to the second order difference equation, which describes a bending phenomenon of a string. We introduce a discrete Laplacian corresponding to the boundary value problem of the second order difference equation. We treat Dirichlet, Dirichlet-Neumann and Neumann boundary conditions. The best constants are given by Chebyshev polynomial.

- 5 高江洲俊光 (群馬大理工) 切断関数に加わった massless  $\phi^4$  モデルの任意の結合定数での基底状態の存在について ..... 15  
 Toshimitsu Takaesu (Gunma Univ.) On the existence of ground state of massless  $\phi^4$  model with cutoffs for all values of coupling constants

概要 The massless  $\phi^4$  model with the ultraviolet cutoff and the spatial cutoff is investigated. Under infrared regularity condition, it is proven that the ground state exists for all valued of coupling constants. It is also shown that the multiplicity of the ground state is finite.

- 6 高江洲俊光 (群馬大理工) 切断関数に加わった相対論的量子電磁力学の系の任意の結合定数での基底状態の存在について ..... 15  
 Toshimitsu Takaesu (Gunma Univ.) On the existence of ground state of relativistic quantum electrodynamics with cutoffs for all values of coupling constants

概要 Relativistic quantum electrodynamics describes the system of Dirac fields coupled to quantized radiation fields. The ultraviolet cutoffs are imposed on both the Dirac field and the radiation field, and the spatial cutoffs are also introduced. Under infrared regularity condition, the existence of the ground state is shown for all values of coupling constants. It is also proven that the multiplicity of the ground state is finite.

- 7 峯 拓 矢 (京都工繊大工芸) 楕円座標を用いた散乱振幅の計算 ..... 15  
 Takuya Mine (Kyoto Inst. Tech.) Computation of the scattering amplitude in the elliptic coordinate

概要 We consider the Schrödinger operators with scalar potentials or magnetic vector potentials. Provided that the eigenequation can be solved by separation of variables in the elliptic coordinate, we give a formula for the quantum mechanical scattering amplitude in terms of the phase shift of the eigenfunctions and the angular Mathieu functions. In particular, we give a formula for the scattering amplitude of the magnetic Schrödinger operator with the two-solenoidal Aharonov–Bohm magnetic field with the quantized magnetic fluxes.

- 8 石 田 敦 英 (追手門学院大経済) On inverse problem for the Schrödinger equation with a repulsive potential ..... 15  
 Atsuhide Ishida (Otemon Gakuin Univ.) On inverse problem for the Schrödinger equation with a repulsive potential

概要 We consider a scattering problem under the Hamiltonian,  $p^2 - x^2 + V$ . In this system, we can see the characteristic property in which the particle disperse in an exponential order in time. This implies that scattering can arise even if we impose a weak decay condition on the potential  $V$ . In this talk, I will mention one of the multidimensional inverse scattering problems and report that the scattering operator can determine uniquely the potential  $V$  by the Enss–Weder time-dependent method.

- 9 梅田 耕平 (北大 理) ラプラス超関数層の大域的切断とそのラプラス変換 ..... 15  
 本多 尚文 (北大 理)  
 Kohei Umeta (Hokkaido Univ.) The global sections of the sheaf of Laplace hyperfunctions and Laplace  
 Naofumi Honda (Hokkaido Univ.) transforms

**概要** H. Komatsu introduce Laplace hyperfunctions in one variable and their Laplace transforms which play a part in solving both linear ordinary differential equations and partial differential equations. Roughly speaking, a Laplace hyperfunction is presented as a difference of boundary values of holomorphic functions with exponential growth at infinity from a complex domain to a real domain. By the theory of Laplace hyperfunctions, we can treat Laplace transforms for functions without any growth conditions in a framework of hyperfunctions. In this talk, we introduce the sheaf of Laplace hyperfunctions in several variables, and we also show several properties of this sheaf.

#### 14:15~15:15 特別講演

- 伊藤 健一 (筑波大数理物質) 一次元離散 Schrödinger 作用素の閾値の分類  
 Kenichi Ito (Univ. of Tsukuba) Classification of threshold properties of one-dimensional discrete Schrödinger operators

**概要** We study the relation between the generalized eigenspace and the asymptotic expansion of the resolvent around the threshold 0 for the one-dimensional discrete Schrödinger operator on  $\mathbb{Z}$ . We decompose the generalized eigenspace into the subspaces corresponding to the eigenstates and the resonance states only by their asymptotics at infinity, and classify the coefficient operators of the singular part of resolvent expansion completely in terms of these eigenspaces. Here the generalized eigenspace we consider is largest possible. For an explicit computation of the resolvent expansion we apply the expansion scheme of Jensen–Nenciu (2001). This talk is based on the recent joint work with Arne Jensen (Aalborg University).

3月16日(日) 第Ⅱ会場

#### 10:00~11:50

- 10 木本 一史 (琉球大理) 行列式の2パラメタ変形と長方形指標公式 ..... 15  
 Kazufumi Kimoto (Univ. of Ryukyus) Two-parameter deformation of the determinant and formulas for rectangular characters

**概要** We introduce a two-parameter deformation of the ordinary determinant and give an expansion formula with respect to immanants. Using this expansion, (i) we show an averaging formula of certain alpha-determinants, and (ii) we present several “determinantal” formulas for irreducible characters of the symmetric group associated with rectangular diagrams.

- 11 森 真 樹 (東 大 数 理) Hecke–Clifford スーパー代数のセルラー構造と既約表現の構成 ..... 15  
 Masaki Mori (Univ. of Tokyo) Cellular structure on the Hecke–Clifford superalgebra and construction  
 of its irreducible representations

概要 The Hecke–Clifford superalgebra is a super version of the Iwahori–Hecke algebra of type A, which is a  $q$ -analogue of the symmetric group algebra. Its irreducible representations are classified by Brundan, Kleshchev and Tsuchioka using a method of categorification of Lie algebras. However their constructions are too abstract to study. We here introduce a more concrete way to produce its irreducible representations using a generalized cellular structure on the superalgebra. It is a generalization of one first applied to the Iwahori–Hecke algebra by Murphy, and developed as theory of cellular algebras by Graham and Lehrer.

- 12 和 地 輝 仁 (北 教 大 釧 路) 複素鏡映群の余不変式環の強レフシェッツ性 ..... 15  
 Akihito Wachi (Hokkaido Univ. of Edu.) The strong Lefschetz property of the coinvariant algebras of complex  
 reflection groups

概要 The coinvariant algebras of real reflection groups are already proved to have the strong Lefschetz property. In this talk we show that the coinvariant algebras of complex reflection groups except five primitive groups have the strong Lefschetz property. We also conjecture that these five types have the strong Lefschetz property.

- 13 田 中 雄 一 郎 (東 大 数 理) Geometry of multiplicity-free representations of  $SO(N)$  and visible ac-  
 tions ..... 15  
 Yuichiro Tanaka (Univ. of Tokyo) Geometry of multiplicity-free representations of  $SO(N)$  and visible ac-  
 tions

概要 For a connected compact simple Lie group of type B or D, we find pairs  $(V_1, V_2)$  of irreducible representations of  $G$  such that the tensor product representation  $V_1 \otimes V_2$  is multiplicity-free by a geometric consideration based on a notion of visible actions on complex manifolds, introduced by T. Kobayashi. The pairs we find exhaust all the multiplicity-free pairs by an earlier combinatorial classification due to Stembridge.

- 14 久 保 利 久 (東 大 数 理) The Dynkin index and parabolic subalgebras of Heisenberg type ..... 15  
 Toshihisa Kubo (Univ. of Tokyo) The Dynkin index and parabolic subalgebras of Heisenberg type

概要 Barchini, Kable, and Zierau constructed a number of conformally invariant systems of differential operators associated to parabolic subalgebras of Heisenberg type. When they constructed such systems of operators, two constants, which play a role for the construction, were defined as the constants of proportionality between two expressions. In this talk we give concrete and uniform expressions for these constants. To do so we introduce a new constant inspired by a formula on the Dynkin index of a finite dimensional representation of a complex simple Lie algebra.

- 15 貝塚 公一 (筑波大数理物質) Scattering theory for the Laplacian on symmetric spaces of noncompact type ..... 15  
 Koichi Kaizuka (Univ. of Tsukuba) Scattering theory for the Laplacian on symmetric spaces of noncompact type

**概要** We construct the scattering theory for the Laplacian on symmetric spaces of noncompact type. We study an asymptotic expansion for the Poisson operator and the resolvent of the Laplacian. Our approach is based on precise analysis for the Helgason Fourier transform and generalized spherical functions (or Eisenstein integrals) on symmetric spaces of noncompact type. As an application of the scattering theory, we prove a conjecture suggested by Strichartz concerning a characterization of a family of generalized eigenfunctions of the Laplacian.

### 13:15~14:15 特別講演

- 廣 惠 一 希 (城西大理) 加法的 Deligne–Simpson 問題とルート系  
 Kazuki Hiroe (Josai Univ.) Additive Deligne–Simpson problem and root systems

**概要** I will explain additive Deligne–Simpson problem which is a kind of inverse problem of Fuchsian differential equations on the Riemann sphere. The existence of the solution of this problem is completely characterized by the language of root systems after W. Crawley-Boevey. He found a relationship between Fuchsian differential equations and representations of quivers and applied the quiver theory to this problem. The aim of this talk is to consider an generalization of this problem to differential equations having an arbitrary number of unramified irregular singular points with poles of any order. After fix our generalized problems, I will discuss a relation between differential equations with irregular singularities and representations of quivers. As an application, the existence of the solutions of the generalized problems will be discussed.

3月17日(月) 第Ⅱ会場

### 9:30~12:00

- 16 後藤 聡 史 (上智大理工) Dynkin 間 connection の flat part の計算 ..... 15  
 Satoshi Goto (Sophia Univ.) Computation of flat parts of inter-Dynkin connections

**概要** All biunitary connetions between ADE Dynkin diagrams were classified by Ocneanu. Here we will call them ‘inter-Dynkin connections’ for short. In this talk we will show computation of flat parts of all inter-Dynkin connections.

- 17 安藤浩志 (Univ. Copenhagen)    Ultraproducts, QWEP von Neumann algebras and the Effros–Maréchal topology ..... 15  
 U. Haagerup (Univ. Copenhagen)  
 C. Winsløw (Univ. Copenhagen)  
 Hiroshi Ando (Univ. Copenhagen)    Ultraproducts, QWEP von Neumann algebras and the Effros–Maréchal topology  
 Uffe Haagerup (Univ. Copenhagen)  
 Carl Winsløw (Univ. Copenhagen)

概要 Haagerup and Winsløw studied topological properties of the Polish space  $\text{vN}(H)$  of von Neumann algebras acting on the separable infinite-dimensional Hilbert space  $H$ . Motivated by the work of Effros, this topology was introduced by Marechal. Among other interesting results, they proved that Kirchberg’s QWEP conjecture is equivalent to the assertion that the set  $\mathcal{F}_{inj}$  of injective factors on  $H$  is dense in  $\text{vN}(H)$ , and moreover a  $\text{II}_1$  factor  $M$  on  $H$  is  $R^\omega$ -embeddable if and only if  $M$  is the Effros–Maréchal limit of a sequence of injective factors. Based on the work of Haagerup–Winsløw and the recent work of the speaker and Haagerup on ultraproducts, we give new characterizations of QWEP von Neumann algebras.

- 18 嵐田 洸一 (東大数理)    Rohlin 性を持つ因子環への局所コンパクト可換群作用 ..... 15  
 Koichi Shimada (Univ. of Tokyo)    Actions of locally compact abelian groups with the Rohlin property on factors

概要 We give a classification theorem of actions of locally compact abelian groups with the Rohlin property on factors. This generalizes a recent work of Masuda and Tomatsu about Rohlin flows on von Neumann algebras.

- 19 岡安 類 (大阪教育大)    Haagerup approximation property for arbitrary von Neumann algebras ..... 15  
 Rui Okayasu (Osaka Kyoiku Univ.)    Haagerup approximation property for arbitrary von Neumann algebras

概要 We attempt presenting a notion of the Haagerup approximation property for an arbitrary von Neumann algebra by using its standard form.

- 20 青井 久 (立命館大理工)    Schlichting completion of Hecke pairs ..... 15  
 山ノ内 毅彦 (東京学大自然)  
 Hisashi Aoi (Ritsumeikan Univ.)    Schlichting completion of Hecke pairs  
 Takehiko Yamanouchi  
 (Tokyo Gakugei Univ.)

概要 We will show that for each Hecke pair of ergodic discrete measured equivalence relations, there exists a Hecke pair of groups determined by an index cocycle associated with the given pair.

- 21 見村万佐人 (東北大理)\* ケーリー位相と粗い幾何学, 第二部: 束化された粗い埋め込み ..... 15  
酒匂宏樹 (東海大理)

Masato Mimura (Tohoku Univ.) Group approximation in Cayley topology and coarse geometry, Part II:  
Hiroki Sako (Tokai Univ.) fibered coarse embedding

概要 In this series of talks with Hiroki Sako, we study coarse disjoint unions of discrete groups. Our main strategy is to exploit the Cayley topology. The topology allows us to regard a group as a point in a compact Hausdorff space. The subject of Part II is generalized embeddability of metric spaces, which is called fibered coarse embeddability. We observe that fibered coarse embeddability of a sequence of finite Cayley graphs can be described by its Cayley boundary groups. As an application, we construct an explicit example of such sequence which does not admit fibered coarse embedding into any uniformly convex Banach spaces or into any Hadamard manifolds.

- 22 縄田紀夫 (千葉大理) Finite group actions on certain stably projectionless  $C^*$ -algebras with the Rohlin property ..... 15

Norio Nawata (Chiba Univ.) Finite group actions on certain stably projectionless  $C^*$ -algebras with the Rohlin property

概要 We shall introduce the Rohlin property for finite group actions on stably projectionless  $C^*$ -algebras and study their basic properties. We shall give some examples of finite group actions on  $\mathcal{W}_2$  and show some classification results of these actions.

- 23 須藤隆洋 (琉球大理)  $C^*$ 環のオイラー標数とオイラー・ポアンカレ公式 ..... 15

Takahiro Sudo (Univ. of Ryukyus) The Euler characteristic and the Euler–Poincaré formula for  $C^*$ -algebras

概要 We revisit and study the Euler characteristic for  $C^*$ -algebras and obtain the Euler–Poincaré formula for  $C^*$ -algebras, as a noncommutative version of the classical Euler–Poincaré formula for spaces.

#### 14:15~15:00

- 24 梶原毅 (岡山大環境) 自己相似写像に付随した  $C^*$ -環のコアの行列表示と  $K$ -群 ..... 15  
綿谷安男 (九大数理)

Tsuyoshi Kajiwara (Okayama Univ.) Matrix representations and  $K$ -groups of the cores of  $C^*$ -algebras associated with self-similar maps  
Yasuo Watatani (Kyushu Univ.)

概要 We write down explicitly matrix forms of the finite cores of  $C^*$ -algebras associated with two examples of self-similar maps, the tent map and Sierpinski Gasket, using a general method of matrix representations of the cores of  $C^*$ -algebras associated with self-similar maps with branched points. We also present a method of calculating matrix forms of the finite cores for general cases. Using explicit matrix forms and their inclusions of the finite cores for the above two examples, we do calculation of  $K$ -groups of the cores of  $C^*$ -algebras associated with them.

- 25 濱田 裕 康 (九 大 I M I) 有理関数をシンボルとする合成作用素から作られる  $C^*$  環 ..... 15  
 Hiroyasu Hamada (Kyushu Univ.)  $C^*$ -algebras generated by composition operators induced by rational functions

概要 Let  $R$  be a rational function with degree at least two, let  $J_R$  be the Julia set of  $R$  and let  $\mu^L$  be the Lyubich measure of  $R$ . We study the  $C^*$ -algebra  $\mathcal{MC}_R$  generated by all multiplication operators by continuous functions in  $C(J_R)$  and the composition operator  $C_R$  induced by  $R$  on  $L^2(J_R, \mu^L)$ . We show that the  $C^*$ -algebra  $\mathcal{MC}_R$  is isomorphic to the  $C^*$ -algebra  $\mathcal{O}_R(J_R)$  associated with the complex dynamical system  $\{R^{on}\}_{n=1}^\infty$ .

- 26 泉池 敬 司 (新 潟 大 理)\* Path connected components in the space of weighted composition operators on the disk algebra ..... 15  
 泉池 佑 子  
 大野 修 一 (日 本 工 大 工)  
 Kei Ji Izuchi (Niigata Univ.) Path connected components in the space of weighted composition operators on the disk algebra  
 Yuko Izuchi  
 Shūichi Ohno (Nippon Inst. of Tech.)

概要 We here study path connected components in the space of weighted composition operators on the disk algebra. We show that the structures of path connected components on the disk algebra and  $H^\infty$  are different.

#### 15:15~16:15 2013年度(第12回)解析学賞受賞特別講演

- 綿谷 安 男 (九 大 数 理) Singularities in operator algebras  
 Yasuo Watatani (Kyushu Univ.) Singularities in operator algebras

概要 We study singularities in operator algebras. Iteration of a rational function gives a complex dynamical system. The associated  $C^*$ -algebra has some information of the branched points of the rational function. A self-similar map also give a  $C^*$ -algebra. The structure of the core of the  $C^*$ -algebra is described in terms of the branched points. We also study Hilbert representations of quivers.

#### 16:30~17:30 特別講演

- 植木 誠 一 郎 (茨 城 大 工) Bargmann–Fock 空間上の線形作用素  
 Sei-Ichiro Ueki (Ibaraki Univ.) Composition and Integral operators on Bargmann–Fock spaces

概要 In this talk, we consider composition, weighted composition and Volterra-type integral operators on Bargmann–Fock spaces over the complex plane.



## 3月18日(火) 第II会場

## 10:00~11:40

- 27 一ノ瀬 弥 (信州大理) ヒルベルト空間上の有界作用素の極分解の一意性について ..... 15  
 岩下加奈子 (信州大理)

Wataru Ichinose (Shinshu Univ.) On the uniqueness of the polar decomposition of bounded operators in  
 Kanako Iwashita (Shinshu Univ.) Hilbert spaces

概要 It is well known that a bounded operator in Hilbert spaces has a polar decomposition, i.e. the product of a partially isometric operator and its square root. Its polar decomposition is not unique in general. In this talk a necessary and sufficient condition is given for an operator to have the unique polar decomposition.

- 28 瀬尾 祐貴 (大阪教育大教育) 作用素幾何平均を用いたヒルベルト  $C^*$ -加群における Buzano 不等式について ..... 10  
 Yuki Seo (Osaka Kyoiku Univ.) Buzano inequality in inner product  $C^*$ -modules via the operator geometric mean

概要 In this talk, we present a Buzano type inequality in an inner product  $C^*$ -module, which is an extension of the Cauchy–Schwarz inequality in an inner product  $C^*$ -module.

- 29 藤井 淳一 (大阪教育大) 補間的作用素平均の Karcher equation における再生性 ..... 15  
 Junichi Fujii (Osaka Kyoiku Univ.) Reproducing property of interpolational operator means in a Karcher equation

概要 For positive invertible operators  $A$  and  $B$ , the two-terms Karcher equation for an operator monotone function  $F$  with  $F(1) = 0$  and  $F'(1) = 1$  has the solution which is a mean-like binary operation for  $A$  and  $B$ . But it is not always an operator mean in the sense of Kubo–Ando. We show that if  $F$  is induced by the derivative of interpolational path  $f_t$ , then the solution is an operator mean induced by  $f_t$ .

- 30 大坂 博幸 (立命館大理工) Interpolation classes and matrix means ..... 15  
 Dinh Trung Hoa (Duy Tan Univ.)  
 Toan M. Ho

(Mathematical Inst., Hanoi)

Hirokyu Osaka (Ritsumeikan Univ.) Interpolation classes and matrix means  
 Dinh Trung Hoa (Duy Tan Univ.)  
 Toan M. Ho

(Mathematical Inst., Hanoi)

概要 We give a ‘local’ integral representation of a matrix connection of order  $n$  corresponding to an interpolation function of the same order. Applying this property, for each integer  $n$ , we can describe an one to one corresponding from the class of matrix connections of order  $n$  to the class of positive  $n$ -monotone functions on  $(0, \infty)$  and the range of this corresponding covers the class of interpolation functions of order  $2n$ . In particular, the space of symmetric connections is isomorphic to the space of symmetric positive  $n$ -monotone functions.

- 31 渚 勝 (千葉大理) 微分による作用素の順序 ..... 10  
 渡辺 春香 (千葉大理)  
 Masaru Nagisa (Chiba Univ.) Order of operators determined by derivatives  
 Haruka Watanabe (Chiba Univ.)

概要 Let  $J$  be an open interval on  $\mathbb{R}$  and  $f$  a real valued  $C^k$ -function. We denote  $H_n = \{A \in M_n(\mathbb{C}) \mid A = A^*\}$  and  $H_n(J) = \{A \in H_n \mid \text{Sp}(A) \subset J\}$ . We consider the condition for  $A, B \in H_n$ , which implies  $A \leq B$ . This problem is motivated by the consideration of reverse order of operator monotone functions. Our main results is, for  $C \in H_n(J)$  with  $C(A - B) = (A - B)C$ ,  $Df(C)(A) \leq Df(C)(B)$  implies  $A \leq B$ , if  $f'(c) > 0$  ( $c \in J$ ), where  $Df(C)(A)$  means the directional Fréchet derivative of  $f$  at  $C$  to  $A$ .

- 32 渚 勝 (千葉大理) Szabó による作用素単調関数 ..... 10  
 和田 州平 (長岡技術科学大電気)  
 Masaru Nagisa (Chiba Univ.) Operator monotonicity of Szabó's function  
 Shuhei Wada (Nagaoka Univ. of Tech.)

概要 The operator monotonicity of the following function

$$S(t) = t^\gamma \frac{(t^{\alpha_1} - 1)(t^{\alpha_2} - 1) \cdots (t^{\alpha_n} - 1)}{(t^{\beta_1} - 1)(t^{\beta_2} - 1) \cdots (t^{\beta_n} - 1)} \quad t \in [0, \infty)$$

which was investigated by Szabó is studied. We first estimate the bounds of

$$\arg \frac{(z^\alpha - 1)}{(z^\beta - 1)} \quad 0 \leq \arg z \leq \pi$$

by an elementary but a bit complicated calculus and apply this result to check the monotonicity.

#### 14:15~15:15

- 33 山崎 丈明 (東洋大理工) Generalized Ando–Hiai inequality for matrix power mean ..... 10  
 Takeaki Yamazaki (Toyo Univ.) Generalized Ando–Hiai inequality for matrix power mean

概要 In this talk, we shall introduce the definition of generalized matrix power mean. Then we shall introduce some properties of it. Especially, we shall introduce generalized Ando–Hiai inequality for generalized matrix power mean.

- 34 伊 佐 浩 史 (前 橋 工 科 大) On relations between operator valued  $\alpha$ -divergence and relative operator  
 伊 藤 公 智 (前 橋 工 科 大) entropies ..... 15  
 亀 井 栄 三 郎  
 遠 山 宏 明 (前 橋 工 科 大)  
 渡 邊 雅 之 (前 橋 工 科 大)  
 Hiroshi Isa (Maebashi Inst. of Tech.) On relations between operator valued  $\alpha$ -divergence and relative operator  
 Masatoshi Ito (Maebashi Inst. of Tech.) entropies  
 Eizaburo Kamei  
 Hiroaki Tohyama  
 (Maebashi Inst. of Tech.)  
 Masayuki Watanabe  
 (Maebashi Inst. of Tech.)

概要 For strictly positive operators, an operator valued  $\alpha$ -divergence is defined based on the difference between the weighted arithmetic mean and the weighted geometric mean. In this report, we show some relations between operator valued  $\alpha$ -divergence and some relative operator entropies. For any  $w \in \mathbf{R}$ , the same forms as the relations between operator valued  $\alpha$ -divergence and relative operator entropies arise on path  $A \natural_w B$ . Moreover, we introduce a sequence version of operator valued  $\alpha$ -divergence for strictly positive operator sequences, and show the relations among sequence version of some operator entropies.

- 35 古 市 茂 (日 大 文 理) ある平均に関するユニタリ不変ノルム不等式 ..... 15  
 Shigeru Furuichi (Nihon Univ.) Unitarily invariant norm inequalities for some means

概要 We define some symmetric homogeneous means and then derive unitarily invariant norm inequalities for them applying the powerful method established by Hiai and Kosaki. Our inequalities give the tighter bounds of logarithmic mean than the inequalities given by Hiai and Kosaki.

- 36 柳 研 二 郎 (山 口 大 理 工) 一般化歪情報量の非エルミート拡張と不確定性関係 ..... 15  
 Kenjiro Yanagi (Yamaguchi Univ.) Non-hermitian extension of generalized skew information and uncertainty relation

概要 In quantum mechanics the expectation value of an observable  $H$  in a quantum system  $\rho$  is expressed by  $\text{Tr}[\rho H]$  and the variance is given by  $\text{Tr}[\rho(A - (\text{Tr}[\rho H])I)^2]$ , respectively. We assume that the observable is not hermitian. Then we study the corresponding uncertainty relation.

# 統計数学

3月15日(土) 第VI会場

9:30~12:00

- 1 田口 大 (立命館大理工) Strong rate of convergence for the Euler–Maruyama approximation of stochastic differential equations with irregular coefficients ..... 10  
Hoang-Long Ngo  
(Hanoi Nat. Univ. of Edu.)
- Dai Taguchi (Ritsumeikan Univ.) Strong rate of convergence for the Euler–Maruyama approximation of stochastic differential equations with irregular coefficients  
Hoang-Long Ngo  
(Hanoi Nat. Univ. of Edu.)

**概要** We consider the Euler–Maruyama approximation for multi-dimensional stochastic differential equations with irregular coefficients. We provide the rate of strong convergence where the possibly discontinuous drift coefficient satisfies a one-sided Lipschitz condition and the diffusion coefficient is Hölder continuous.

- 2 中田 寿夫 (福岡教育大) 切断された非負確率変数列に関する極限定理 ..... 15  
Toshio Nakata (Fukuoka Univ. of Edu.) Limit theorems for nonnegative independent random variables with truncation

**概要** We investigate asymptotic behavior of sums of independent and truncated random variables specified by  $P(0 \leq X < \infty) = 1$  and  $P(X > x) \asymp x^{-\alpha}$  for  $\alpha > 0$ . By varying truncation levels we study strong laws of large numbers and central limit theorems. These are extensions of the results of Györfi and Kevei (2011) concerning the St. Petersburg game.

- 3 福山 克司 (神戸大理)\* The central limit theorem for subsequences of Erdős–Fortet sequence ..... 5  
簗原 貴文 (タイヨーエレクト) .....  
Katusi Fukuyama (Kobe Univ.) The central limit theorem for subsequences of Erdős–Fortet sequence  
Takafumi Minohara (Taiyo Elec Co.)

**概要** We give the equivalent condition for the central limit theorem for subsequences of Erdős–Fortet sequence.

- 4 樋口 保成 (神戸大理) 2次元 ising パーコレーションにおける incipient infinite cluster measure ..... 10  
木下一成 (神戸大理) の構成 .....  
竹居 正登 (横浜国大工)  
Yu Zhang (Univ. Colorado)
- Yasunari Higuchi (Kobe Univ.) Construction of the incipient infinite cluster measure for 2D ising percolation  
Kazunari Kinoshita (Kobe Univ.)  
Masato Takei (Yokohama Nat. Univ.)  
Yu Zhang (Univ. Colorado)

**概要** We consider the percolation problem in the high-temperature Ising model on the two-dimensional square lattice at or near critical external fields. The incipient infinite cluster (IIC) measure in the sense of Kesten is constructed. As a consequence, we can obtain some geometric properties of IIC. The result holds also for the triangular lattice.

- 5 村山太郎 (金沢大 自然)\* 電磁場内の相対論的スピンなし量子力学的粒子に対する零質量極限問題  
 一瀬孝 (金沢大 自然) ..... 15  
 Taro Murayama (Kanazawa Univ.) The zero mass limit problem for a relativistic spinless quantum particle  
 Takashi Ichinose (Kanazawa Univ.) in an electromagnetic field

概要 We consider mass-parameter-dependent solutions of the imaginary time magnetic relativistic Schrödinger equation which describes a spinless quantum particle. It is shown that they converge as functionals of Lévy processes represented by stochastic integrals of stationary Poisson point processes if the mass-parameter goes to zero.

- 6 南就将 (慶大 医) Definition and self-adjointness of the stochastic Airy operator ..... 15  
 Nariyuki Minami (Keio Univ.) Definition and self-adjointness of the stochastic Airy operator

概要 It has been shown that the stochastic Airy operator, which was considered by Ramirez, Rider and Virag, and which is the "Schrödinger operator" on the half line whose potential term consists of Gaussian white noise plus a linear term tending to plus infinity, can naturally be realized as a closed symmetric operator in the Hilbert space of square integrable functions and is self-adjoint with probability one. Moreover, it has purely discrete spectrum.

- 7 矢野孝次 (京大 理) 周遊路を結合してできる過程の汎関数極限定理 ..... 15  
 Kouji Yano (Kyoto Univ.) Functional limit theorems for processes pieced together from excursions

概要 A notion of convergence of excursion measures is introduced. It is proved that convergence of excursion measures imply convergence in law on the càdlàg path space for the processes pieced together from excursions accompanied with the local time at the origin and its inverse. This general theorem is applied to obtain homogenization theorems of jumping-in extensions for self-similar processes.

- 8 伊藤悠 (京大 情報) Lyons' extension theorem via fractional calculus ..... 15  
 Yu Ito (Kyoto Univ.) Lyons' extension theorem via fractional calculus

概要 On the basis of fractional calculus, we will introduce an alternative proof of Lyons' extension theorem for Geometric Hölder rough paths together with an explicit expression of the extension map. The proofs of constructing the extension of rough paths and the continuity of the extension map due to Lyons (1998) are based on discrete approximating arguments such as dealing with limits of Riemann sums. However, our approach will not use the arguments and will be more straightforward. In fact, the explicit expression of the extension map introduced in this talk will be provided as the usual Lebesgue integral by using the fractional derivatives.

- 9 竹内敦司(阪市大理) Large deviation principle for stochastic functional differential equations ..... 15  
 Atsushi Takeuchi (Osaka City Univ.) Large deviation principle for stochastic functional differential equations

**概要** Consider stochastic functional differential equations depending on past histories, which determines the non-Markovian process. We shall study the large deviations for the family of the solution process, and apply it to the study on the asymptotic behavior of the density. The Malliavin calculus plays a crucial role in our argument.

#### 14:30~15:30 特別講演

- 深澤正彰(阪大理) 高頻度データに対する Whittle 尤度  
 Masaaki Fukasawa (Osaka Univ.) Whittle likelihood for high frequency data

**概要** We consider statistical estimation of the diffusion coefficient of an Ito process from high frequency data. This has been thoroughly investigated in the case that the values of the Ito process are available as data. A quasi likelihood based on the Euler-Maruyama approximation works there. Here we are interested in the case where only available are integrated values of the Ito process. We encountered this situation at the very beginning of the history of stochastic differential equation modeling, namely, the Langevin dynamics of molecular system. Even if the Ito process is a diffusion, the integrated process is not Markov any more. The Euler-Maruyama approximation fails to give a consistent estimate. Only a few studies have been done and no efficient estimator has been available so far. In this study, we construct a new quasi likelihood inspired by Whittle's approximation to the covariance function of stationary Gaussian time series. We show the consistency, asymptotic mixed normality and asymptotic efficiency of our estimator. Technical difficulties come from the fact that the Whittle likelihood is not a martingale estimating function and so, beyond the standard framework of high frequency data analysis. Also, the model is LAMN but not LAN. Therefore results for Gaussian time series are not useful here.

#### 15:45~16:45 2013年度(第12回)解析学賞受賞特別講演

- 渡部俊朗 無限分解可能分布と Lévy 測度の関係  
 (会津大コンピュータ理工)

Toshiro Watanabe (Univ. of Aizu) Relation between infinitely divisible distributions and their Lévy measures

3月16日(日) 第VI会場

#### 9:00~11:25

- 10 高澤真一郎(神戸大理)\* 非有界予測ゲームにおける有限個の戦略による大数の法則の収束レート ..... 10  
 Shin-Ichiro Takazawa (Kobe Univ.) The convergence rate of the strong law of large numbers by a finite number of strategies in the unbounded forecasting game

**概要** We consider the convergence rate of the strong law of large numbers in the framework of game-theoretic probability of Shafer and Vovk. We show that in the predictably unbounded forecasting game Skeptic can weakly force the strong law of large numbers by a single strategy.

- 11 盧 曉 南 (名 大 情 報) On affine-invariant strictly cyclic Steiner quadruple systems ..... 15  
 Xiao-Nan Lu (Nagoya Univ.) On affine-invariant strictly cyclic Steiner quadruple systems

**概要** A Steiner quadruple system denoted by  $\text{SQS}(v)$ , is a pair  $(V, \mathcal{B})$ , where  $V$  is a finite set of  $v$  points, and  $\mathcal{B}$  is a collection of 4-subsets of  $V$ , called blocks or quadruples, such that each 3-subset of  $V$  appears exactly once in  $\mathcal{B}$ . If  $\text{SQS}(v)$  admits a cyclic permutation whose stabilizer of any block is trivial, it is said to be strictly cyclic, denoted by  $\text{sSQS}(v)$ . In this talk, we consider an  $\text{sSQS}(2p)$  over  $\mathbb{Z}_{2p}$  admitting all the units of  $\mathbb{Z}_{2p}$  as multipliers, which is said to be affine-invariant. A new family of graphs related to the special projective linear groups over finite fields is introduced for the construction of an affine-invariant  $\text{sSQS}(2p)$ . The 1-factors of such graphs give rise up to the base blocks of an affine-invariant  $\text{sSQS}(2p)$ .

- 12 生 亀 清 貴 (東京理大理工) 順序カテゴリ正方分割表における準対角指数対称モデル ..... 10  
 山 本 紘 司 (阪 大 医)  
 富 澤 貞 男 (東京理大理工)  
 Kiyotaka Iki (Tokyo Univ. of Sci.) Quasi-diagonal exponent symmetry model for ordinal square contin-  
 Kouji Yamamoto (Osaka Univ.) gency tables.  
 Sadao Tomizawa (Tokyo Univ. of Sci.)

**概要** For square contingency tables with ordered categories, we propose a simple quasi-symmetry model in which the expected frequency has an exponential form along every subdiagonal of the table. It also give the theorem such that Tomizawa's (1992) diagonal exponent symmetry (DES) model holds if and only if the proposed model and the model of equality of row and column marginal means hold.

- 13 地 寄 頌 子 (東京理大理工) Difference system of sets with size 3 ..... 10  
 宮 本 暢 子 (東京理大理工)  
 Shoko Chisaki (Tokyo Univ. of Sci.) Difference system of sets with size 3  
 Nobuko Miyamoto (Tokyo Univ. of Sci.)

**概要** Difference systems of sets (DSS) are combinatorial structures introduced by Levenshtein in 1971, which are a generalization of cyclic difference sets and arise in connection with code synchronization. A DSS is a collection of  $t$  disjoint subsets  $Q_i, 0 \leq i \leq t-1$ , of any finite abelian group  $G$  of order  $v$  such that every element of  $G \setminus \{0\}$  appears at least  $\rho$  times in the multiset  $\{a-b | a \in Q_i, b \in Q_j, 0 \leq i \neq j \leq t-1\}$ . In this talk, we define new blocks with size 3 and present the conditions that these blocks form a perfect DSS.

- 14 山 田 紘 頌 (東京理大理工) Baer subplanes による直交配列の構成 ..... 15  
 宮 本 暢 子 (東京理大理工)  
 Kohei Yamada (Tokyo Univ. of Sci.) A construction of orthogonal arrays from Baer subplanes  
 Nobuko Miyamoto (Tokyo Univ. of Sci.)

**概要** It is a fundamental and important problem in combinatorics and incidence geometry to find construction methods of orthogonal arrays. Fuji-hara and Kamimura (1993) proposed a construction method of orthogonal arrays with non-prime power number of symbols. In this talk, we improved this method and thereby experimentally give many new orthogonal arrays with much smaller runs and indices, compared with the arrays obtained from the earlier work. These new arrays also have a non-prime power number of symbols.

- 15 鳥居 武司 (阪府大工) 分割型ユニットをもつ nested row-column design の構成法 ..... 15  
 栗木 進二 (阪府大工)  
Takeshi Torii (Osaka Pref. Univ.) Two construction methods of a nested row-column design with split  
Shinji Kuriki (Osaka Pref. Univ.) units

**概要** We consider two construction methods of a nested row-column design with split units for a two-factor experiment. The whole plot treatments occur in a generalized Youden design and a bottom stratum universally optimum nested row and column design. The subplot treatments occur in a proper block design. We consider a mixed linear model for the observations with a four-step randomization and we give the stratum efficiency factors for such nested row-column designs with split units, which have the general balance property.

- 16 門脇 聖 (松江工高専) An equivalence theorem between an affine resolvable SRGD design and  
 景山 三平 (広島工大) a difference scheme ..... 15  
Satoru Kadowaki  
 (Matsue Coll. of Tech.) An equivalence theorem between an affine resolvable SRGD design and  
 a difference scheme  
 Sanpei Kageyama  
 (Hiroshima Inst. of Tech.)

**概要** Much construction of (affine) resolvable PBIB designs with their combinatorial properties has been discussed in literature. Kadowaki and Kageyama (2009) provided some methods of construction of such block designs.

**Theorem 1.1** [**Kadowaki and Kageyama (2009)**]. The existence of a Hadamard matrix of order  $2x$  is equivalent to the existence of an affine resolvable symmetric SRGD design with parameters  $v = b = 4x, r = k = 2x, \lambda_1 = 0, \lambda_2 = x, q = x; m = 2x, n = 2$ .

We can show the following as a generalization of Theorem 1.1.

**Theorem 2.1.** Let  $s$  be a prime or a prime power. Then the existence of a  $DS(m, s; x)$  is equivalent to the existence of an affine resolvable symmetric SRGD design with parameters  $v = b = xs^2, r = k = xs, \lambda_1 = 0, \lambda_2 = x, q = x; m = xs, n = s$ .

- 17 栗田 正秀 (国際自然研) Existence conditions for balanced fractional  $3^m$  factorial designs of res-  
 兵頭 義史 olution  $R(\{00, 10, 01, 20, 11\})$  ..... 15  
 (岡山理大総合情報研・国際自然研)  
弓場 弘 (国際自然研)  
Masahide Kuwada  
 (Int. Inst. for Nat. Sci.) Existence conditions for balanced fractional  $3^m$  factorial designs of res-  
 olution  $R(\{00, 10, 01, 20, 11\})$   
Yoshifumi Hyodo  
 (Okayama Univ. of Sci./Int. Inst. for Nat. Sci.)  
Hiromu Yumiba (Int. Inst. for Nat. Sci.)

**概要** We consider a fractional  $3^m$  factorial design derived from an  $SA(m; \{\lambda_{xm-x-yy}\})$ , where  $m \geq 4$ . In this situation, we give a necessary and sufficient condition for an SA to be a balanced fractional  $3^m$  factorial design of resolution  $R(\{00, 10, 01, 20, 11\})$ . Such a design is characterized by the suffixes  $x$  and  $y$  of the index  $\lambda_{xm-x-yy}$  of an SA.



- 18 平尾 将剛 (東京女大数理) Characterizing optimum designs in terms of finite irreducible reflection  
 澤 正憲 (名大情報) groups ..... 15  
 Masatake Hirao Characterizing optimum designs in terms of finite irreducible reflection  
 (Tokyo Woman's Christian Univ.) groups  
 Masanori Sawa (Nagoya Univ.)

概要 In this talk we give a geometric characterization of D-optimal experimental designs on the unit ball that consist of corner vectors associated with finite irreducible reflection groups.

- 19 松原 和樹 (広島大理) Constructions of pairwise additive cyclic BIB designs ..... 10  
 景山 三平 (広島工大)  
 Kazuki Matsubara (Hiroshima Univ.) Constructions of pairwise additive cyclic BIB designs  
 Sanpei Kageyama  
 (Hiroshima Inst. of Tech.)

概要 The existence of pairwise additive balanced incomplete block (BIB) designs has been discussed with direct and recursive constructions in Matsubara et al. (2007, 2013). In this talk, pairwise additive cyclic BIB designs and a special array are proposed and some recursive methods of constructing such designs with the special array are provided. It is finally shown that  $2$  PACB( $2^m 3^n t, 2, 1$ ) for any integers  $m(\geq 0)$ ,  $n(\geq 0)$  and  $t(\geq 1)$  such that  $m \not\equiv 1 \pmod{4}$ ,  $n \neq 1, 2$ ,  $\gcd(t, 6) = 1$  and  $(m, n, t) \neq (0, 0, 1)$  can be constructed.

### 3月17日(月) 第VI会場

#### 9:00~12:00

- 20 小山 民雄 (神戸大理) 多面体領域の正規確率の満たすホロノミック系 ..... 15  
 Tamio Koyama (Kobe Univ.) Holonomic modules associated with multivariate normal probabilities of  
 polyhedra

概要 The probability content of a convex polyhedron with a multivariate normal distribution can be regarded as a real analytic function. We give a system of linear partial differential equations with polynomial coefficients for the function and show that the system induces a holonomic module. The rank of the holonomic module is equal to the number of nonempty faces of the convex polyhedron, and we provide an explicit Pfaffian equation (an integrable connection) that is associated with the holonomic module.

- 21 清 智也 (慶大理工) メビウス変換により作られる球面上の分布族 ..... 15  
 Tomonari Sei (Keio Univ.) A family of distributions on the sphere induced by Möbius transforma-  
 tions

概要 In directional statistics, the wrapped Cauchy family is known as the family of probability distributions on the unit circle induced by the Moebius transformations. In this talk, we derive a family on higher-dimensional spheres by using the transformations. The family is shown to have a hyperbolic structure with respect to the Fisher-Rao information metric. The distribution is not characterized by the Brownian exiting distribution as opposed to the circle case.

- 22 安 芸 重 雄 (関西大システム理工) クーポンコレクター問題と統計的推測 ..... 10  
 平 野 勝 臣 (城 西 大 理)  
 Sigeo Aki (Kansai Univ.) Coupon collector's problems with statistical applications  
 Katuomi Hirano (Josai Univ.)

概要 Some new exact distributions on coupon collector's waiting time problems are given based on a generalized Polya urn sampling. In coupon collector's waiting time problems with  $m$  kinds of coupons, the observed order of  $m$  kinds of coupons corresponds to a permutation of  $m$  letters uniquely. Using the property of coupon collector's problems, a statistical model on the permutation group of  $m$  letters is proposed for analyzing ranked data. In the model, as the parameters mean the proportion of the  $m$  kinds of coupons, the observed ranking can be intuitively understood.

- 23 井 上 潔 司 (成 蹊 大 経 済) 非サイクル有向グラフ上の連, スキャンの分布 ..... 10  
 安 芸 重 雄 (関西大システム理工)  
 Kiyoshi Inoue (Seikei Univ.) Distributions of numbers of runs and scans on directed acyclic graphs  
 Sigeo Aki (Kansai Univ.) with generation

概要 We introduce a class of a directed acyclic graph on the assumption that the collection of random variables indexed by the vertices has a Markov property. We present a flexible approach for the study of the exact distributions of runs and scans on the directed acyclic graph by extending the method of conditional probability generating functions. The results presented here provide a wide framework for developing the exact distribution theory of runs and scans on the graphical models. We also show that our theoretical results can easily be carried out through some computer algebra systems and give some numerical results for run and scan statistics in order to demonstrate the feasibility of our theoretical results. Finally, we address the parameter estimation in the distributions of runs and scans.

- 24 佃 康 司 (総合研究大学院大) エルゴード的拡散過程のドリフトパラメータ変化検出のための  $L^2$  アプ  
 西 山 陽 一 ローチ ..... 15  
 (統計数理研・総合研究大学院大)  
 Koji Tsukuda An  $L^2$  approach to detect a change of parameters in an ergodic diffusion  
 (Grad. Univ. for Adv. Stud.) process model  
 Yoichi Nishiyama  
 (Inst. of Stat. Math./Grad. Univ. for Adv. Stud.)

概要 In this presentation, to test a change of drift parameters in an ergodic diffusion process model is discussed. For this problem, past studies chose  $\ell^\infty$  space as the framework of weak convergences of proposed *sup* type test statistics. On the other, we will develop an approach by limit theorems in  $L^2$  space and propose a weighted integral type test statistic, which is expected to have better power in many cases.

- 25 明石 郁哉 (早大理工) 非母数的時系列モデルにおける仮説検定の最適性に対する LAN 及び GMM  
アプローチ ..... 15  
Fumiya Akashi (Waseda Univ.) LAN and frequency domain GMM approach to optimality of hypothesis  
testing

概要 In this talk, we develop the testing theory for second order stationary processes with spectral restriction. The model concerned is defined nonparametrically and the functional of the spectral density summarizes information about pivotal quantities of the model. It is known that many important quantities in stationary time series are often expressed as a functional of the spectral density. We apply the approach which is mainly based on the local asymptotic normality (LAN) to the frequency domain generalized method of moments (GMM) framework, and elucidate the local power of tests to discuss local asymptotic optimality.

- 26 劉 言 (早大理工) M-estimation in time series and its applications ..... 15  
Yan Liu (Waseda Univ.) M-estimation in time series and its applications

概要 In this talk, we give the asymptotics for M-estimators in time domain of the time series analysis without the assumption that the objective function is differentiable with respect to the parameter at the true value. Especially, we define the objective function of M-estimator as two-variate function, i.e. the function of scale parameters and coefficient parameters, which may be transformed to correspond to the Whittle estimator in frequency domain. The result can be extended to  $M_m$  estimators or be corresponded to the estimators in frequency domain approach. Examples and the applications of the result will also be presented.

- 27 谷川 明夫 (大阪工大情報) Identification of partially unknown system matrix of discrete-time sto-  
澤田 祐一 (京都工繊大工芸) chastic systems via pseudomeasurement approach ..... 10  
Akio Tanikawa (Osaka Inst. of Tech.) Identification of partially unknown system matrix of discrete-time sto-  
Yuichi Sawada (Kyoto Inst. Tech.) chastic systems via pseudomeasurement approach

概要 A new identification method of discrete-time linear stochastic systems is proposed. We assume that some entries of the system matrix are unknown and propose a new method which identifies those unknown entries and the state vector of the system simultaneously. The key idea of the proposed method is the use of pseudomeasurement which is a fictitious observation process on the unknown entries and has been introduced by Kameyama and Ohsumi for continuous-time linear stochastic systems.

- 28 八木文香 (東京理大理) A test for equality of two mean vectors with three-step monotone missing data ..... 15  
 瀬尾隆 (東京理大理)  
 Ayaka Yagi (Tokyo Univ. of Sci.) A test for equality of two mean vectors with three-step monotone missing data  
 Takashi Seo (Tokyo Univ. of Sci.)

**概要** We consider the problem of testing equality of two mean vectors when the data have three-step monotone pattern missing observations. The maximum likelihood estimators of the mean vector and the covariance matrix for the case of two sample problem with a three-step monotone missing data are given. In this paper, we propose an approximate upper percentile of the Hotelling's  $T^2$  type statistic where the each of data set has a three-step monotone missing data and the population covariance matrices are equal. This result is an extension of one sample problem given in Yagi and Seo (2013). Further, we obtain the approximate simultaneous confidence intervals for all linear compounds of the difference of two mean vectors. Finally, the accuracy of the approximation is investigated by Monte Carlo simulation.

- 29 矢田和善 (筑波大数理物質) 高次元データの2次判別分析について ..... 15  
 青嶋誠 (筑波大数理物質)  
 Kazuyoshi Yata (Univ. of Tsukuba) Quadratic-type classifiers for high-dimensional data  
 Makoto Aoshima (Univ. of Tsukuba)

**概要** In this talk, we consider a quadratic-type classifier for multiclass, high-dimensional data. We first show that the classifier holds the consistency in misclassification rates for multiclass, high-dimensional classification. We also show that the classifier is asymptotically distributed as a normal distribution when the data dimension goes to infinity. The classifier contains a function of scale parameters. We propose a criterion to evaluate the performance of the classifier and choose the optimal function to define the best classifier.

- 30 赤平昌文 (筑波大) Asymptotic comparison of the MLE and MCLE of a natural parameter up to the second order for a truncated exponential family of distributions ..... 15  
 Masafumi Akahira (Univ. of Tsukuba) Asymptotic comparison of the MLE and MCLE of a natural parameter up to the second order for a truncated exponential family of distributions

**概要** For a truncated exponential family of distributions with a natural parameter and a truncation parameter as a nuisance parameter, it is known that the maximum likelihood estimators (MLEs) of the natural parameter for known truncation parameter and unknown truncation one and the maximum conditional likelihood estimator (MCLE) of the natural parameter for unknown truncation one are asymptotically equivalent. Here, the asymptotic expansions of the MLEs and MCLE are derived up to the second order, and their second order asymptotic variances are obtained. A bias-adjusted MLE and the MCLE of the natural parameter for unknown truncation parameter are also shown to be second order asymptotically equivalent, and further the second order asymptotic loss of the bias-adjusted MLE for unknown truncation parameter relative to the MLE for known truncation one is given.

- 31 赤平昌文 (筑波大) Asymptotic comparison of the MLE and MCLE up to the second order  
 橋本真太郎 (筑波大数理物質) for a two-sided truncated exponential family ..... 10  
 小池健一 (筑波大数理物質)  
 大谷内奈穂 (筑波大数理物質)  
 Masafumi Akahira (Univ. of Tsukuba) Asymptotic comparison of the MLE and MCLE up to the second order  
 Shintaro Hashimoto (Univ. of Tsukuba) for a two-sided truncated exponential family  
 Ken-ichi Koike (Univ. of Tsukuba)  
 Nao Ohyauchi (Univ. of Tsukuba)

**概要** In a similar way to Akahira (2013, Math. Res. Note 2013-001, Inst. Math., Univ. Tsukuba), for a two-sided truncated exponential family of distributions with a natural parameter and two truncation parameters as nuisance parameters, the asymptotic expansions of the maximum likelihood estimator (MLE) of the natural parameter for known truncation parameters, the MLE and the maximum conditional likelihood estimator (MCLE) of the natural parameter for unknown truncation parameters are derived, their asymptotic variances are obtained up to the second order, a bias-adjusted MLE and the MCLE of the natural parameter for unknown truncation parameters are shown to be second order asymptotically equivalent, and the second order asymptotic loss of the bias-adjusted MLE for unknown truncation parameters relative to the MLE for known truncation ones is given.

#### 14:30~15:30 特別講演

津熊久幸 (東邦大医) 行列型パラメータの推定問題における統計的決定理論  
 Hisayuki Tsukuma (Toho Univ.) Decision-theoretic estimation of parameter matrices

**概要** The estimation problems of parameter matrices in multivariate models are considered from a decision-theoretic perspective. We first treat the problem of estimating mean matrix and discuss minimaxity, admissibility and inadmissibility of Bayes estimators relative to a quadratic loss. Next, the estimation problem of normal covariance matrix is addressed, and we provide an alternative proof for minimaxity and an improvement method on the minimax estimator.

#### 15:45~16:45 特別講演

鈴木大慈 (東工大情報理工) マルチプルカーネル学習とスパース推定の統計的性質  
 Taiji Suzuki (Tokyo Tech) Statistical properties of multiple kernel learning and sparse estimation

**概要** We discuss statistical properties of multiple kernel learning (MKL) which has been developed in the machine learning community. Kernel methods utilize the inner product defined on a reproducing kernel Hilbert space as an inner-product between data points to realize non-linear flexible data analysis. The performance of a kernel method is affected by the choice of the inner-product associated with the kernel function. MKL is a method that automatically selects and constructs an appropriate kernel from observed data. MKL is closely related to  $L_1$ -regularized sparse estimation. In this presentation, we overview the recent theoretical developments about statistical performances of MKL.

# 応 用 数 学

3月15日(土) 第IX会場

9:30~11:50

- 1 潮 和 彦 (近畿大理工) Balanced  $C_4$ -foil designs and related designs ..... 15  
 Kazuhiko Ushio (Kinki Univ.) Balanced  $C_4$ -foil designs and related designs

概要 In graph theory, the decomposition problem of graphs is a very important topic. Various type of decompositions of many graphs can be seen in the literature of graph theory. This paper gives balanced  $C_4$ -foil designs and related designs.

- 2 佐 藤 巖 (小山工高専) A note on the discrete-time evolutions for quantum walk on a graph  
 今 野 紀 雄 (横浜国大工) ..... 15  
 樋 口 雄 介 (昭和大教養)  
 瀬 川 悦 生 (東北大情報)  
 Iwao Sato (Oyama Nat. Coll. of Tech.) A note on the discrete-time evolutions for quantum walk on a graph  
 Norio Konno (Yokohama Nat. Univ.)  
 Yusuke Higuchi (Showa Univ.)  
 Etsuo Segawa (Tohoku Univ.)

概要 For a quantum walk on a graph, there exist many kinds of operators for the discrete-time evolution. We give a general relation between the characteristic polynomial of the evolution matrix of a quantum walk on edges and that of a kind of transition matrix of a classical random walk on vertices. Furthermore we determine the structure of the positive support of the cube of some evolution matrix, which is said to be useful for isospectral problem in graphs, under a certain condition.

- 3 Jung-Rae Cho (Pusan Nat. Univ.) Travel groupoids on infinite graphs ..... 10  
 Jeongmi Park (Pusan Nat. Univ.)  
 佐 野 良 夫 (筑波大システム情報)  
 Jung-Rae Cho (Pusan Nat. Univ.) Travel groupoids on infinite graphs  
 Jeongmi Park (Pusan Nat. Univ.)  
 Yoshio Sano (Univ. of Tsukuba)

概要 The notion of travel groupoids was introduced by L. Nebeský in 2006 in connection with a study on geodetic graphs. A travel groupoid is a pair of a set  $V$  and a binary operation  $*$  on  $V$  satisfying two axioms. For a travel groupoid, we can associate a graph. We say that a graph  $G$  has a travel groupoid if the graph associated with the travel groupoid is equal to  $G$ . Nebeský gave a characterization for finite graphs to have a travel groupoid.

In this talk, we consider travel groupoids on infinite graphs. We answer a question posed by Nebeský, and we also give a characterization for infinite graphs to have a travel groupoid.

- 4 Jung-Rae Cho (Pusan Nat. Univ.) The non-confusing travel groupoids on a finite connected graph ..... 10  
 Jeongmi Park (Pusan Nat. Univ.)  
佐野良夫 (筑波大システム情報)  
 Jung-Rae Cho (Pusan Nat. Univ.) The non-confusing travel groupoids on a finite connected graph  
 Jeongmi Park (Pusan Nat. Univ.)  
Yoshio Sano (Univ. of Tsukuba)

**概要** The notion of travel groupoids was introduced by L. Nebeský in 2006 in connection with a study on geodetic graphs. A travel groupoid is a pair of a set  $V$  and a binary operation  $*$  on  $V$  satisfying two axioms. For a travel groupoid, we can associate a graph. We say that a graph  $G$  has a travel groupoid if the graph associated with the travel groupoid is equal to  $G$ . A travel groupoid is said to be non-confusing if it has no confusing pairs. Nebeský showed that every finite connected graph has at least one non-confusing travel groupoid.

In this talk, we consider non-confusing travel groupoids on a given finite connected graph, and we give a one-to-one correspondence between the set of all non-confusing travel groupoids on a finite connected graph and a combinatorial structure in terms of the given graph.

- 5 斎藤 明 (日大文理) Contraction-critical graphs with respect to independence number ..... 15  
 M. D. Plummer (Vanderbilt Univ.)  
Akira Saito (Nihon Univ.) Contraction-critical graphs with respect to independence number  
 Michael D. Plummer (Vanderbilt Univ.)

**概要** Let  $\alpha(G)$  be the independence number of a graph  $G$ . A graph  $G$  is said to be contraction-critical (with respect to the independence number) if  $\alpha(G/e) < \alpha(G)$  holds for every edge  $e$  in  $G$ , where  $G/e$  is the graph obtained from  $G$  by the contraction of  $e$ . In this talk, we give a characterization of the contraction-critical graphs.

- 6 中本 敦浩 (横浜国大環境情報) 閉曲面上の分割問題 ..... 15  
 小関 健太  
 (国立情報学研・JST ERATO)  
野口 健太 (慶大理工)  
 Atsuhiro Nakamoto Division problems on closed surfaces  
 (Yokohama Nat. Univ.)  
 Kenta Ozeki  
 (Nat. Inst. of Information/JST ERATO)  
Kenta Noguchi (Keio Univ.)

**概要** A map of a surface  $F^2$  is a graph with a fixed 2-cell embedding on  $F^2$ . A triangulation of a surface  $F^2$  is a map on  $F^2$  in which every face is triangular. We call it even if every vertex degree is even. A quadrangulation of a surface  $F^2$  is a map on  $F^2$  in which every face is quadrangular. We consider the following two problems; For a given quadrangulation  $G$  of a surface  $F^2$ , can we get an even triangulation by adding a diagonal edge to each face of  $G$ ? For a given triangulation  $G$  of a surface  $F^2$ , can we find a bipartite quadrangulation of  $F^2$  as a subgraph of  $G$ ?

- 7 鈴木 有 祐 (新潟 大理) 多面体的四角形分割に対する減少操作について ..... 15  
 Yusuke Suzuki (Niigata Univ.) Reductional operations for polyhedral quadrangulations

概要 We show that for any nonspherical surface  $F^2$ , there exists only finitely many irreducible polyhedral quadrangulations of  $F^2$ , up to homeomorphism, by using seven reductional operations.

- 8 Guantao Chen (Georgia State Univ.) Spanning Halin subgraph を持たない平面三角形分割 ..... 15  
 榎 本 彦 衛 (早 大)  
 小 関 健 太  
 (国立情報学研・JST ERATO)  
 土 屋 翔 一 (東京理大理)

Guantao Chen (Georgia State Univ.) Plane triangulations without spanning Halin subgraphs  
 Hikoe Enomoto (Waseda Univ.)  
 Kenta Ozeki  
 (Nat. Inst. of Information/JST ERATO)  
 Shoichi Tsuchiya (Tokyo Univ. of Sci.)

概要 A Halin graph, defined by Halin, is a plane graph  $H = T \cup C$  such that  $T$  is a spanning tree of  $H$  with no vertices of degree 2 where  $|T| \geq 4$  and  $C$  is a cycle whose vertex set is the set of leaves of  $T$ . Halin graphs are edge-minimal 3-connected graphs with many interesting properties. In 1975, Lovász and Plummer conjectured that every 4-connected plane triangulation has a spanning Halin subgraph. In this talk, we show that there is an infinite family of 5-connected plane triangulations which have no spanning Halin subgraph. Consequently, the Lovász and Plummer conjecture does not hold.

#### 14:30~16:40

- 9 奈 良 知 恵 変形および裏返し可能性 —二重被覆多面体の展開図について— ..... 15  
 (東海大阿蘇教養教育センター)  
 伊 藤 仁 一 (熊本大教育)  
 Chie Nara (Tokai Univ.) Transformability and reversibility of unfoldings of doubly-covered poly-  
 Jin-ichi Itoh (Kumamoto Univ.) hedra

概要 If a convex polyhedron  $W$  is dissected into a finite number of pieces which can be rearranged to form a convex polyhedron  $X$  with hinges,  $W$  is called *transformable* to  $X$ , and if the surface of  $W$  is transformed to the interior of  $X$  except some edges of pieces,  $W$  is called *reversible* to  $X$ . Our main result is that for a reflective space-filler  $P$ , any convex unfolding  $W$  of a doubly covered polyhedron of  $P$  is transformable to any convex unfolding  $X$  of a doubly covered polyhedron of a mirror image  $P^m$  of  $P$ , where we assume both  $W$  and  $X$  include  $P$  and  $P^m$  respectively.



- 10 古 門 麻 貴 (横浜国大経営) The condition for the generation of the stepped surfaces in terms of the  
 伊 藤 俊 次 (東 邦 大 理) modified Jacobi–Perron algorithm ..... 15  
 安 富 真 一 (東 邦 大 理)  
 Maki Furukado (Yokohama Nat. Univ.) The condition for the generation of the stepped surfaces in terms of the  
 Shunji Ito (Toho Univ.) modified Jacobi–Perron algorithm  
 Shin-ichi Yasutomi (Toho Univ.)

概要 P. Arnoux and S. Ito introduce the tiling substitution on the stepped surface related to the irreducible and Pisot substitution in 2001. We are especially interested in the condition for the generation of the stepped surface by the sequence of the tiling substitution in terms of the modified Jacobi–Perron algorithm. We observe the geometrical property of the patches which construct the stepped surface and we have succeeded in getting the admissible sequence of the tiling substitution which generates the stepped surface in terms of the modified Jacobi–Perron algorithm.

- 11 見 村 万 佐 人 (東 北 大 理)\* 球面同値, バナッハスペクトルギャップ, 補外法 ..... 12  
 Masato Mimura (Tohoku Univ.) Sphere equivalence, Banach spectral gaps, and extrapolation

概要 We introduce the notion of sphere equivalence between Banach spaces, and show that the spectral gap property is stable under this equivalence relation. As a byproduct, we obtain certain generalization of Matousek’s extrapolation, and prove that a family of expanders realizes the worst order of the distortions for a certain large class of Banach spaces.

- 12 見 村 万 佐 人 (東 北 大 理)\* 多分割等周定数と有限グラフへの非原始的群作用 ..... 12  
 Masato Mimura (Tohoku Univ.) Multi-way isoperimetries and imprimitive group actions on finite graphs

概要 We prove certain inequalities between multi-way isoperimetries of vertex-transitive graphs. As a byproduct, we show the existence of system of imprimitivity of certain size if there is a gap between multi-way isoperimetric constants.

- 13 大 杉 英 史 (立 教 大 理) 辺凸多面体の辺の個数の最大値 ..... 20  
 鹿 間 章 宏 (阪 大 情 報)  
 日 比 孝 之 (阪 大 情 報)  
 森 垂 貴 (阪 大 情 報)  
 Hidefumi Ohsugi (Rikkyo Univ.) The maximum number of edges of an edge polytope  
 Akihiro Shikama (Osaka Univ.)  
 Takayuki Hibi (Osaka Univ.)  
 Aki Mori (Osaka Univ.)

概要 Let  $[d] = \{1, \dots, d\}$  be the vertex set and  $\Omega_d$  the set of finite simple graphs on  $[d]$ , where  $d \geq 3$ . We write  $\varepsilon(G)$  for the number of edges of the edge polytope  $\mathcal{P}_G \subset \mathbb{R}^d$  of  $G \in \Omega_d$ . For example,  $\varepsilon(K_d) = d(d-1)(d-2)/2$ , where  $K_d$  is the complete graph on  $[d]$ . Let  $\mu_d = \max\{\varepsilon(G) : G \in \Omega_d\}$ . We wish to find  $G \in \Omega_d$  with  $\mu_d = \varepsilon(G)$  and to compute  $\mu_d$ . One may expect  $\mu_d = \varepsilon(K_d)$ . In fact, it turns out to be true that  $\mu_d = \varepsilon(K_d)$  for each  $3 \leq d \leq 14$ . However, it will be proved that, for each  $d \geq 15$ , one has  $\mu_d \geq \varepsilon(K_d) + 50(d-14)$ . It remains unsolved to find  $G \in \Omega_d$  with  $\mu_d = \varepsilon(G)$  and to compute  $\mu_d$  if  $d \geq 15$ .

- 14 村井 聡 (山口大理) 多面体的複体の flag  $f$ -列について ..... 10  
 柳川 浩二 (関西大システム理工)  
 Satoshi Murai (Yamaguchi Univ.) On flag  $f$ -vectors of polyhedral complexes  
 Kohji Yanagawa (Kansai Univ.)

概要 In 1985, Bayer and Billera proved that the dimension of the vector space spanned by all flag  $f$ -vectors of  $d$ -dimensional polytopes is a Fibonacci number. We introduce an analogue of this result for polyhedral complexes.

- 15 八森 正泰 (筑波大システム情報)<sup>b</sup> 単体的複体の Hereditary-shellability と vertex decomposability ..... 15  
 柏原 賢二 (東大総合文化)  
 Masahiro Hachimori Hereditary-shellability and vertex decomposability of simplicial com-  
 (Univ. of Tsukuba) plexes  
 Kenji Kashiwabara (Univ. of Tokyo)

概要 We say a simplicial complex is hereditary-P if every restriction to a subset of the vertex set satisfies the property P. In this talk we discuss the relation between hereditary-shellability and vertex decomposability of simplicial complexes. The main result is to show the existence of 2- and higher dimensional simplicial complexes that are hereditary-shellable but not vertex decomposable. This especially shows that hereditary-shellability and hereditary-vertex decomposability are different for 2- and higher dimensions.

- 16 富江 雅也 (盛岡大文) Pattern avoiding set partitions における半順序集合構造について ..... 10  
 Masaya Tomie (Morioka Univ.) Poset structures for pattern avoiding set partitions

概要 In this talk we consider poset structures of the set partitions which avoid a pattern of length 3. Sagan introduced the concept of pattern avoiding set partitions and Goyt and Sagan developed their statistics. There are five patterns of length 3 and especially we focus on 12/3-avoiding set partitions. The number of maximal chains of the posets are enumerated by the Catalan numbers. The posets are lattices and self dual. Furthermore they are flag-symmetric posets. We also calculate the Mobius numbers of the intervals of the posets.

**16:50~17:50 特別講演**

岡本 吉 央 (電 通 大) 平面グラフにおける辺長の自由性

Yoshio Okamoto

Free edge lengths in plane graphs

(Univ. of Electro-Comm.)

**概要** We study the impact of metric constraints on the realizability of planar graphs. Let  $G$  be a subgraph of a planar graph  $H$  (where  $H$  is the “host” of  $G$ ). The graph  $G$  is *free* in  $H$  if for every choice of positive lengths for the edges of  $G$ , the host  $H$  has a planar straight-line embedding that realizes these lengths; and  $G$  is *extrinsically free* in  $H$  if all constraints on the edge lengths of  $G$  depend on  $G$  only, irrespective of additional edges of the host  $H$ .

We characterize all planar graphs  $G$  that are free in every host  $H$ ,  $G \subseteq H$ , and all the planar graphs  $G$  that are extrinsically free in every host  $H$ ,  $G \subseteq H$ . The case of cycles  $G = C_k$ , provides a new version of the celebrated carpenter’s rule problem. Even though cycles  $C_k$ ,  $k \geq 4$ , are not extrinsically free in some triangulations, every “nondegenerate” choice of edge lengths are realizable, where the lengths are considered degenerate if the cycle can be flattened (in 1-dimensions) in two different ways.

Separating triangles, and separating cycles in general, play an important role in our arguments. We show that every star is free in a 4-connected triangulation (which has no separating triangle).

Joint work with Zachary Abel, Robert Connelly, Sarah Eisenstat, Radolav Fulek, Filip Morić, Tibor Szabó, and Csaba D. Tóth.

3月16日(日) 第IX会場

**9:30~11:30**

- 17 蛭子井 博 孝 One elementary expression of Zeta(3) ..... 15  
(Oval Research Center)

Hirofuka Ebisui (Oval Research Center) One elementary expression of Zeta(3)

**概要** Zeta(3) is not known as elementary expression using elementary constants. we got the expression in Maple Soft environment. Namely, Zeta(3) is expressed by using Pi and ln(2) and fractional numbers. We report this maple Pg and It’s Output list.

- 18 加 部 通 明 (関東職業能力開発大)  $\chi^2$  検定の調整化残差を用いた焼結部品のキズ検出法 ..... 15  
Michiaki Kabe How to detect scratches of sintered parts by using adjusted residuals of  
(Kanto Polytechnic Coll.)  $\chi^2$  test

**概要** To detect scratches of sintered parts is achieved by human’s sight, even if science and technology are developing in this day. We consider how to detect scratches of sintered parts by using adjusted residuals of  $\chi^2$  test.

- 19 溝口 佳寛 (九大 IMI) 有限オートマトンとスティッカー系に関する Coq による形式証明について  
 田中 久治 (佐賀大理工) ..... 15  
 坂下 一生 (九大 IMI)  
 井口 修一 (九大数理)  
 Yoshihiro Mizoguchi (Kyushu Univ.) Formal proofs for automata and sticker systems  
 Hisaharu Tanaka (Saga Univ.)  
 Issei Sakashita (Kyushu Univ.)  
 Shuichi Inokuchi (Kyushu Univ.)

**概要** We implemented operations appeared in the theory of automata using the Coq proof-assistant. A language which contains infinite elements is defined using ssreflect (a Small Scale Reflection Extension for the Coq system). We also implemented the modules for sticker systems. Păun and Rozenberg introduced a concrete method to transform an automaton to a sticker system in 1998. One of our aims is to present formal proofs of the correctness of their transformation. We modified some of their definitions to improve their insufficient results. We note that all of our formulation are written in Coq and we show some examples of machine-checkable proofs.

- 20 小笠原義仁 (早大理工) On spaces from primitive chaos ..... 15  
 大石 進一 (早大理工)  
 Yoshihito Ogasawara (Waseda Univ.) On spaces from primitive chaos  
 Shin'ichi Oishi (Waseda Univ.)

**概要** The concept of primitive chaos was proposed in the field of physics [1]. In this talk, the emergence of two contrast spaces from the primitive chaos is shown from a topological viewpoint [2,3]. References [1] Y. Ogasawara: J. Phys. Soc. Jpn. 79 (2010) 15002. [2] Y. Ogasawara and S. Oishi: RIMS Kôkyûroku 1833 (2013) 98. [3] Y. Ogasawara and S. Oishi: J. Phys. Soc. Jpn., in print.

- 21 G. Bacquela (日大文理) Offensive alliances in trees ..... 15  
 江川 嘉美 (東京理大理)  
 今村 茂樹 (日大文理)  
 木村 健司 (東京理大工)  
 斎藤 明 (日大文理)  
 Guillaume Bacquela (Nihon Univ.) Offensive alliances in trees  
 Yoshimi Egawa (Tokyo Univ. of Sci.)  
 Shigeki Imamura (Nihon Univ.)  
 Kenji Kimura (Tokyo Univ. of Sci.)  
 Akira Saito (Nihon Univ.)

**概要** Let  $G = (V, E)$  be a graph having vertex set  $V$  and edge set  $E$ . We denote by  $N(v)$  the neighbourhood of a vertex  $v$ . For  $S \subset V$  we denote  $N(S) = \cup_{v \in S} N(v)$ . We define the boundary  $\partial S$  as the set  $N(S) - S$ . A non-empty set of vertices  $S \subset V$  is said to be an offensive alliance if for every vertex  $v \in \partial S$ ,  $|N(v) \cap S| > |N(v) \cap (V - S)|$ .

Favaron et al. [Offensive alliances in graphs, *Discuss. Math. Graph Theory* **24** (2004), no 2, 263–275] have proved that every graph of order  $n \geq 2$  has an offensive alliance of order at most  $2n/3$ . For a path on  $n$  vertices, it has an offensive alliance of order at most  $\lfloor n/2 \rfloor$ . In this talk, we consider a tree other than a path. We prove that a tree of order  $n$  that is not a path has an offensive alliance of order at most  $3n/8 + 9/8$ .

- 22 江 川 嘉 美 (東京理大理) 各頂点の次数が高い全域木 ..... 15  
 小 関 健 太  
 (国立情報学研・JST ERATO)  
 Yoshimi Egawa (Tokyo Univ. of Sci.) Spanning trees with vertices having large degrees  
Kenta Ozeki  
 (Nat. Inst. of Information/JST ERATO)

概要 Because of its relationship to problems on Hamiltonian cycles, a spanning tree with degree constraint is one of the most important and attractive topics in graph theory and computer science. The purpose of this talk is to study a necessary and “almost” sufficient condition for the existence of spanning trees satisfying lower bounds on degrees.

### 13:00~14:30

- 23 上 別 府 陽 (島根大総合理工) Generalized Mycielski グラフの boxicity について ..... 15  
 Akira Kamibeppu (Shimane Univ.) On the boxicity of generalized Mycielski graphs

概要 A box in Euclidean  $k$ -space is the Cartesian product  $I_1 \times I_2 \times \dots \times I_k$ , where  $I_j$  is a closed interval on the real line. The boxicity of a graph  $G$ , denoted by  $\text{box}(G)$ , is the minimum integer  $k$  such that  $G$  can be represented as the intersection graph of a family of boxes in Euclidean  $k$ -space. In this talk, for every positive integer  $k$ , we present how one constructs a new graph whose boxicity is more than  $k$ , where one starts with any graph. Our main result is that for a graph  $G$  with a focal vertex, the boxicity of the Mycielski graph  $M_2(G)$  is more than that of  $G$ .

- 24 V. Borozan (Univ. Paris-Sud 11) From edge-coloring to strong edge-coloring ..... 10  
 Gerard Jennhwa Chang  
 (National Taiwan Univ.)  
 N. Cohen (Univ. Paris-Sud 11)  
藤 田 慎 也 (横浜市大国際総合)  
 N. Narayanan  
 (Indian Institute of Tech.)  
 R. Naserasr (Univ. Paris-Sud 11)  
 P. Valicov (Univ. Paris-Sud 11)  
 Valentin Borozan (Univ. Paris-Sud 11) From edge-coloring to strong edge-coloring  
 Gerard Jennhwa Chang  
 (National Taiwan Univ.)  
 Nathann Cohen (Univ. Paris-Sud 11)  
Shinya Fujita (Yokohama City Univ.)  
 N. Narayanan  
 (Indian Institute of Tech.)  
 Reza Naserasr (Univ. Paris-Sud 11)  
 Petru Valicov (Univ. Paris-Sud 11)

概要 Some recent results on strong edge-coloring will be reviewed.

- 25 芳 木 武 仁 (東 大 数 理) 微分可能性を要求しない関数に対する Walsh 係数の減少について ..... 15  
 Takehito Yoshiki (Univ. of Tokyo) The decay of the Walsh coefficients of a function which may not be differentiable

概要 We show the decay of the Walsh coefficients of a function  $f$  which may not be differentiable. By using them, we obtain new Koksma–Hlawka type inequalities which estimate the integration error  $\text{Err}(f, P)$  for the quasi-Monte Carlo integration by a point set called a digital net  $P$  over the finite field of order 2. To show the decay of the Walsh coefficients, we introduce dyadic difference.

- 26 鈴 木 航 介 (東 大 数 理) WAFOM on abelian groups and the MacWilliams identity for the Dick weight ..... 15  
 Kousuke Suzuki (Univ. of Tokyo) WAFOM on abelian groups and the MacWilliams identity for the Dick weight

概要 We study quasi-Monte Carlo (QMC) rules for numerical integration of high smooth integrands defined over the  $s$ -dimensional unit cube. As a dyadic  $n$ -digit discretized version of Dick's inequality for  $n$ -smooth integrands, Matsumoto, Saito, and Matoba have later introduced Walsh figure of merit (WAFOM)  $\text{WAFOM}(P)$  for an  $\mathbb{F}_2$ -digital net  $P$  that can be employed as a practically computable quality criterion of QMC point sets. The key ingredient for obtaining WAFOM is the Dick weight. We generalize the notion of the Dick weight and WAFOM for digital nets over a general finite abelian group and we give the MacWilliams identity of weight enumerator polynomials for the Dick weight, with which we can obtain a computable formula of WAFOM.

- 27 原 瀬 晋 Low-WAFOM point sets with small  $t$ -values for quasi-Monte Carlo integration ..... 15  
 (東工大イノベーションマネジメント) Shin Harase (Tokyo Tech) Low-WAFOM point sets with small  $t$ -values for quasi-Monte Carlo integration

概要 Matsumoto, Saito, and Matoba recently proposed the Walsh figure of merit (WAFOM), which is a criterion of quasi-Monte Carlo point sets constructed by digital nets. WAFOM is quickly computable, so that it enables us to search for quasi-Monte Carlo point sets by random search. In this talk, we search for low-WAFOM point sets with small discrepancy. For this, we consider digital  $(t, m, s)$ -nets, and apply random linear scrambling with non-singular lower triangular matrices. Our approach is to select good point sets from scrambled digital  $(t, m, s)$ -nets in terms of WAFOM. By numerical experiments, we show that the obtained point sets improve the rates of convergence for smooth functions and are robust for non-smooth functions.

## 3月17日(月) 第IX会場

## 9:00~12:00

- 28 堀 口 俊 二 (新潟産大経済) Halley 法と拡張 Halley 法 (土倉・堀口・村瀬・Halley 法) の収束比較式 I (等式の場合) ..... 10  
 Shunzi Horiguchi Formulas to compare the convergence of Halley method and the extended Halley method (Tsuchikura-Horiguchi-Murase-Halley method) (in the case of an equation)

概要 We extend the Halley method. We give the formulas to compare the convergence of the Halley method and extended the Halley method (Tsuchikura-Horiguchi-Murase-Halley method) (in the case of an equation). We found the extended Halley method from Murase's recurrence formulas of the square  $x^2$  in 1673.

- 29 堀 口 俊 二 (新潟産大経済) Halley 法と拡張 Halley 法 (土倉・堀口・村瀬・Halley 法) の収束比較式 I (等式の場合) の数値計算 ..... 10  
 Shunzi Horiguchi Numerical calculations of the formulas to compare the convergence of Halley method and the extended Halley method (Tsuchikura-Horiguchi-Murase-Halley method) (in the case of an equation)

概要 We extend the Halley method. We will give the numerical calculations of the formulas to compare the convergence of the Halley method and extended the Halley method (Tsuchikura-Horiguchi-Murase-Halley method) (in the case of an equation). We found the extended Halley method from Murase's recurrence formulas of the square  $x^2$  in 1673.

- 30 神 崎 秀 嗣 (京大ウイルス研) 臨床検査技師養成校における数学教育への一考察 ..... 15  
 Hidetsugu Kohzaki (Kyoto Univ.) A Study on the quality assurance of mathematics education for medical technologist/paramedics in Japan.

概要 The author teaches mathematics/statistics and chemistry at a medical technology school. Mathematics, especially statistics, and chemistry are not necessarily the favorite subjects of Japanese students receiving paramedical education. So, the author taught mathematics/statistics needed for medical technologist in regular classes. Moreover, the author taught remedial mathematics learned at elementary schools, junior high schools and high school in Science I. Additionally, the author conducted supplementary separate classes for students who had poor results of the proficiency test of admission immediately. As a result, in the final exam of mathematics/statistics, it can be all pass. So they had a positive impact to the national examination. The author would like to contribute to the Medical technologists training.

- 31 青木隆明 (京大経済研) Some mathematical properties of the dynamically inconsistent Bellman equation: A note on the two-sided altruism dynamics ..... 15  
 Takaaki Aoki (Kyoto Univ.) Some mathematical properties of the dynamically inconsistent Bellman equation: A note on the two-sided altruism dynamics

概要 This article describes some dynamic aspects on dynastic utility incorporating two-sided altruism with an OLG setting. We analyzed the special case where the weights of two-sided altruism are dynamically inconsistent. The Bellman equation for two-sided altruism proves to be reduced to one-sided dynamic problem, but the effective discount factor is different only in the current generation. We show that a contraction mapping result of value function cannot be achieved in general, and that there can locally exist an infinite number of self-consistent policy functions with distinct steady states (indeterminacy of self-consistent policy functions).

- 32 中嶋文雄 (岩手大教育)\* A mathematical approach to the economy of atomic power generation ..... 15  
 Fumio Nakajima (Iwate Univ.) A mathematical approach to the economy of atomic power generation

概要 In 1970's Dr. Schumacher appealed that the atomic power generation should be immediately abolished because of the various poisonous influence due to radition. The purpose of this paper is to innovate a mathematical model of the economy of the atomic power generation in our society and to conduct Schumacher's appeal as a theorem.

- 33 Shy Der Lin Caputo fractional derivative and its applications ..... 15  
 (Chung Yuan Christian Univ.)  
 Shy Der Lin Caputo fractional derivative and its applications  
 (Chung Yuan Christian Univ.)

概要 Abstract The main objective of this talk is to present the Caputo type fractional derivatives and integrals in the theory of fractional mathematical analysis, and use the techniques of special intergal transform to get the solutions of fractional differential and integral equations in various fields. In the past two decades, the widely-investigated subject of fractional calculus has remarkably gained importance and popularity due to its demonstrated applications in numerous diverse fields of science and engineering, and the fields of special functions. In this talk is also to present in the fields of Caputo Laplace transform of the fractional derivative to solve the useful fractional-order differential equations in the fields of applied mathematics which allied topics of mathematical analysis and applicable mathematics with the theoretic and applicable aspects of the associated Riemann–Liouville fractional integrals and fractional derivatives.

- 34 梅田典晃 (明大理工) On non-well-definedness of the diffusive sign by the heat equation .... 15  
 Noriaki Umeda (Meiji Univ.) On non-well-definedness of the diffusive sign by the heat equation

概要 We consider a solution of a simple Cauchy problem for a semilinear heat equation, and we consider a sign of the solution. The diffusive sign by the equation is defined by the limit of sign of the solution as time tend to zero. In this lecture we consider the case when the diffusive sign is not well-defined.



- 35 久保英夫 (北大理) チホノフ正則化法を用いた原資産の分配金の同定について ..... 15  
 陳超 (東北大情報)  
 Hideo Kubo (Hokkaido Univ.) Identifying dividend of underlying assets from option prices using Tikhonov  
 Chao Chen (Tohoku Univ.) regularization

概要 In predicting the financial market and pricing financial derivatives, the volatility, dividend rate, and covariance of the underlying financial assets are very important parameters. However, they can not be directly observed from the market data. One way of obtaining these parameters is to calculate, or in other words, to identify them from the option prices. This is called the inverse problem of option pricing. There are researches which had been working on identifying asset volatility and also researches on identifying dividend on the Sobolev space satisfying Lipschitz condition from option prices, and we will focus on how to identify dividend rate on the Sobolev space in this study.

- 36 伊藤直治 (奈良教育大教育) Bezout 整域上の一般化 Sylvester 方程式に関する一考察 ..... 15  
 Naoharu Ito (Nara Univ. of Edu.) A note on generalized Sylvester equations over Bezout domains

概要 This paper studies the consistency of the generalized Sylvester equation over Bezout domains. A result on rank minimization which extends Roth's equivalence theorem is given.

- 37 須志田隆道 (龍谷大理工) Voronoi spiral tilings ..... 15  
 日詰明男 (龍谷大理工)  
 山岸義和 (龍谷大理工)  
 Takamichi Sushida (Ryukoku Univ.) Voronoi spiral tilings  
 Akio Hizume (Ryukoku Univ.)  
 Yoshikazu Yamagishi (Ryukoku Univ.)

概要 We study the topology and geometry of the Voronoi tiling of the punctured plane  $\mathbb{C}^* := \mathbb{C} \setminus \{0\}$  with the spiral sequence  $S = \{\zeta^j\}_{j \in \mathbb{Z}}$  generated by a single element  $\zeta = re^{i\theta}$ ,  $0 < r < 1$ . It is intimately related to the phyllotaxis theory. A Voronoi spiral tiling forms a hexagonal or quadrilateral tiling. In particular, the case of quadrilateral tilings is a special case of the Voronoi spiral tilings called degenerate. The set of the generators  $\zeta$  of quadrilateral tilings is a countable union of real algebraic curves parameterized by the divergence angle  $\theta$ . When  $\theta/2\pi$  is a fixed quadratic irrational, we consider the set of the plastochrone ratios  $r$  such that the generators  $\zeta$  give rise to quadrilateral tilings, then it is shown that the limit set of the shapes of the quadrilaterals, as  $r \rightarrow 1$ , is a finite set. In particular, if  $\theta/2\pi$  is linearly equivalent to the golden section  $\tau = \frac{1+\sqrt{5}}{2}$ , then the limit of the shapes of the quadrilaterals, as  $r \rightarrow 1$ , is the square.

#### 14:30~16:30

- 38 村川秀樹 (九大数理) 細胞接着の数値モデル: 拡散か移流か ..... 15  
 Hideki Murakawa (Kyushu Univ.) Mathematical models of cell-cell adhesion: diffusion or advection

概要 Cells adhere to each other through the binding of cell adhesion molecules at the cell surface. This process, known as cell-cell adhesion, is fundamental in many areas of biology, including early embryo development, tissue homeostasis and tumour growth. In this talk we consider mathematical models of this phenomenon.

- 39 秋山正和 (北大電子研) 平面内細胞極性の数理モデル ..... 15  
 山崎正和 (秋田大医)  
 Masakazu Akiyama (Hokkaido Univ.) A mathematical model of planar cell polarity  
 Masakazu Yamazaki (Akita Univ.)

**概要** In considering the morphogenesis of tissue of multicellular organisms, the orientation of the cell placement is very important. For example, in the inner ear of a person, a function [hear the sound] is produced by cells called hair cells arranged in a particular direction. This is a phenomenon caused by the individual cells have an asymmetry spatial pattern, behavior of such cells are called PCP (Planar cell polarity). Recently, in hair cells other than, PCP is a universal phenomenon seen in the various organisms and tissue. Hence many researchers study about PCP phenomena. In this session, we will introduce our mathematical model for PCP.

- 40 森 竜樹 (龍谷大理工) Structure and stability of stationary solutions to a reaction-diffusion  
 久藤 衡介 (電通大情報理工) model for cell polarization ..... 15  
 辻川 亨 (宮崎大工)  
 長山 雅晴 (北大電子研)  
 四ツ谷 晶二 (龍谷大理工)  
 Tatsuki Mori (Ryukoku Univ.) Structure and stability of stationary solutions to a reaction-diffusion  
 Kousuke Kuto model for cell polarization  
 (Univ. of Electro-Comm.)  
 Tohru Tsujikawa (Univ. of Miyazaki)  
 Masaharu Nagayama (Hokkaido Univ.)  
 Shoji Yotsutani (Ryukoku Univ.)

**概要** We are interested in the structure and stability of stationary solutions to a reaction-diffusion model for cell polarization by Y. Mori, A. Jilkin and L. Edelstein-Keshet in SIAM J. Appl. Math (2011). We have proposed a new method to represent the bifurcation sheets which determine the global bifurcation structure including all bifurcation branches. We investigate the stability of them numerically.

- 41 渡辺 雅二 (岡山大環境) Mathematical study on roll of microorganisms in microbial depolymer-  
 河合 富佐子 ization processes ..... 15  
 (京都工繊大ナノ材料・デバイス研究センター)  
 Masaji Watanabe (Okayama Univ.) Mathematical study on roll of microorganisms in microbial depolymer-  
 Fusako Kawai (Kyoto Inst. Tech.) ization processes

**概要** A mathematical model for a microbial depolymerization process is described. Experimental results are introduced into analysis to solve inverse problems numerically for the molecular factor and the time factor of a degradation rate. An initial value problem is solved to simulate the microbial depolymerization process.

- 42 長山雅晴 (北大電子研) 樟脳円盤の集団運動に対する数理解析 ..... 15  
 若井健 (金沢大自然)  
 西慧 (北大電子研)  
 小林康明 (北大電子研)  
 井倉弓彦 (北大理)  
 中田聡 (広島大理)  
 Masaharu Nagayama (Hokkaido Univ.) Mathematical analysis for the collective motion of camphor disks  
 Ken Wakai (Kanazawa Univ.)  
 Kei Nishi (Hokkaido Univ.)  
 Yasuaki Kobayashi (Hokkaido Univ.)  
 Yumihiko Ikura (Hokkaido Univ.)  
 Satoshi Nakata (Hiroshima Univ.)

**概要** We consider the collective motion of camphor disks in an annulus water channel. As an experimental result, when the radius of the water channel is small, two camphor disks move in opposite directions, while if the radius of one is large, the two camphor disks move in the same direction. Moreover, some camphor disks display a billiard phenomenon when put on the water channel. We will investigate the mechanism of these collective motions by means of numerical simulation, reduction methods and linearized stability analysis of the mathematical model for the camphor motion.

- 43 池田幸太 (明大先端数理) 円環水路上の樟脳船の集団運動に現れる渋滞現象 ..... 15  
 長山雅晴  
 (JST CREST・北大電子研)  
 友枝明保  
 (JST CREST・明大研究・知財)  
 栄伸一郎 (九大IMI)  
 Kota Ikeda (Meiji Univ.) Jamming phenomena in collective motion of camphor boats in an an-  
 Masaharu Nagayama nular water channel  
 (JST CREST/Hokkaido Univ.)  
 Akiyasu Tomoeda  
 (JST CREST/Meiji Univ.)  
 Shin-Ichiro Ei (Kyushu Univ.)

**概要** Unidirectional motion along an annular water channel can be observed in an experiment. Moreover, the collective motion of camphor boats in the water channel exhibits a homogeneous and an inhomogeneous state, depending on the number of boats. In a theoretical research, the unidirectional motion is represented by a traveling wave solution in a model. Hence it suffices to investigate a linearized eigenvalue problem in order to prove the destabilization of a traveling wave solution. However, the eigenvalue problem is too difficult to analyze even if the number of camphor boats is 2. Hence we need to make a reduction on the model. In this work, we reduce the model to an ordinary differential system by the center manifold theory.

**16:45~17:45 特別講演**

シュワドレンカカレル

(金沢大理工)

非線形発展問題に対する時間半離散化法について

Karel Svadlenka (Kanazawa Univ.)

On the method of semidiscretization in time for nonlinear evolutionary problems

**概要** When a semidiscretization in time is applied, initial boundary value problems for evolutionary partial differential equations with variational structure can be approximated by a sequence of stationary problems. The resulting stationary problems are usually of elliptic type and can be written as minimization problems. This fact often provides a great advantage when dealing with various types of nonlinearities in the original equation, both from the viewpoint of mathematical analysis and from the viewpoint of numerical solution. In this talk, an outline of the semidiscretization method for parabolic and hyperbolic partial differential equations of second order will be presented, and its application to existence and regularity analysis and numerical simulation will be explained. Several examples will be shown, covering nonlinear problems such as evolutions with global constraints, evolutionary free boundary problems with contact angle condition, motion of elastic curves around obstacles and constrained multiphase mean curvature flow.

3月18日(火) 第IX会場

**10:00~11:30**

- 44 徳永清久 (福岡工大情報科学研) 三角形二重積分の近似値 ..... 15

Kiyohisa Tokunaga

(Fukuoka Inst. of Tech.)

Approximate values of a triangular double integral

**概要** The advantage of our triangular integral over the conventional rectangular integral is to have only one limit at infinity. An approximate value is uniquely determined because it has only one limit. Approximate values of a triangular double integral are shown in the table and in the graph. The calculation processes of limit at infinity in detail are shown in the appendix.

- 45 榎原航也 (明大理工) 解析的境界を持つ Jordan 領域における双極子法 ..... 15

Koya Sakakibara (Meiji Univ.)

The dipole simulation method in a Jordan region with an analytic boundary

**概要** In this talk, we consider the dipole simulation method (DSM) applied to a boundary value problem for the Laplace operator in a two-dimensional Jordan region. We prove that if we use an interior mapping function of the region to determine the collocation points and the charge points, then DSM gives a solution which converges to the exact solution under a hypothesis that the boundary curve is real analytic. We also obtain an error estimate which says that if the boundary data is real analytic, then an exponential convergence occurs.

- 46 周冠宇 (東大数理) Error analysis of a finite volume scheme for the Keller–Segel system of  
 齊藤宣一 (東大数理) chemotaxis ..... 15  
 Guanyu Zhou (Univ. of Tokyo) Error analysis of a finite volume scheme for the Keller–Segel system of  
 Norikazu Saito (Univ. of Tokyo) chemotaxis

概要 A linear finite volume scheme for a simplified Keller–Segel system of chemotaxis is considered. The conservation of positivity and total of mass of the scheme is proved. We then derive the error estimates. Numerical experiments are performed to verify the theoretical results and the numerical blow-up of the solution of large mass is investigated.

- 47 E. Ginder (北大電子研) The hyperbolic BMO algorithm ..... 15  
 K. Švadlenka (金沢大理工)  
 Elliott Ginder (Hokkaido Univ.) The hyperbolic BMO algorithm  
 Karel Švadlenka (Kanazawa Univ.)

概要 We introduce a method for computing interfacial motions governed by curvature dependent acceleration. Our method is a thresholding algorithm of the BMO-type which, instead of utilizing a diffusion process, thresholds evolution by the wave equation to obtain the desired interfacial dynamics. We also develop the numerical method and present the results of its application, including an investigation of the volume preserving motions.

- 48 大塚厚二 (広島国際学院大情報) 一般 J 積分を使った最適形状設計 ..... 15  
 Khoji Ohtsuka Shape optimization using GJ-integral  
 (Hiroshima Kokusai Gakuin Univ.)

概要 There is difficulty of shape optimization in mixed boundary value problems by the reason of the singularity at the intersection between different boundary conditions. Using GJ-integral, we can get the optimal shape in such cases.

- 49 齊藤善弘 確率微分方程式系に対する改良ホイン法 ..... 10  
 (岐阜聖徳学園大経済情報)  
 Yoshihiro Saito Improved Heun method for systems of stochastic differential equations  
 (Gifu Shotoku Gakuen Univ.)

概要 The stochastic Heun method is an explicit method for stochastic differential equations. It is known that the Heun method cannot attain strong order 1, except for special case. In this talk we propose an strong first order scheme which add a correction term to the Heun method.

## 14:15~15:45

- 50 谷 口 隆 晴 (神戸大システム情報) 境界付き多様体上における有限要素外積解析の弱形式の適切性について  
 土 屋 卓 也 (愛 媛 大 理) ..... 10  
 Takaharu Yaguchi (Kobe Univ.) On well-posedness of the weak form of the finite element exterior calcu-  
 Takuya Tsuchiya (Ehime Univ.) lus on manifolds with boundaries

概要 The finite element exterior calculus (FEEC) is a unified approach to deriving finite element schemes for a class of elliptic partial differential equations by using geometric tools, such as the Hodge decomposition and the Poincaré inequality. In order to extend this framework to the PDEs on manifolds with boundaries, in this talk, we introduce a weak form of the PDEs that is same as the weak form of FEEC, and investigate its well-posedness.

- 51 渡 部 善 隆 (九 大 情 報) 線形作用素に対する可逆性の検証と精度保証付きノルム評価の改良につ  
 木 下 武 彦 (京 大 数 理 研) いて ..... 15  
 中 尾 充 宏 (佐世保工高専)  
 Yoshitaka Watanabe (Kyushu Univ.) An improvement of invertibility verifications for linear elliptic operators  
 Takehiko Kinoshita (Kyoto Univ.)  
 Mitsuhiro T. Nakao  
 (Sasebo Nat. Coll. of Tech.)

概要 The aim of this lecture is to propose a procedure to verify the invertibility of linear elliptic partial differential operators with computable upper bound. We have already proposed a numerical method to verify the invertibility and to bound which is based on a projection and its constructive a priori error estimates. We will give an improvement of our previous method with numerical examples.

- 52 杉 谷 宜 紀 (東 大 数 理) Stokes 方程式に対する片側境界値問題 ..... 15  
 周 冠 宇 (東 大 数 理)  
 齊 藤 宣 一 (東 大 数 理)  
 Yoshiki Sugitani (Univ. of Tokyo) A unilateral open boundary value problem for the Stokes equations  
 Guanyu Zhou (Univ. of Tokyo)  
 Norikazu Saito (Univ. of Tokyo)

概要 As an open boundary condition (a kind of artificial boundary conditions) for viscous incompressible fluids flow simulation, we propose a unilateral boundary condition. With our boundary condition, the Navier–Stokes equation satisfies an energy inequality so that we can avoid numerical instability in 3D simulations. In this paper, we consider a model Stokes problem and establish the well-posedness by using a variational inequality. The treatment of a pressure part is of particular interest. We also study the penalty method as a practical numerical method.

- 53 佐々木多希子 (東大数理) 非線形波動方程式の差分分解の爆発について ..... 15  
 齊藤 宣一 (東大数理)  
 Takiko Sasaki (Univ. of Tokyo) Linearly implicit finite difference scheme for a nonlinear wave equation  
 Norikazu Saito (Univ. of Tokyo) with application to approximation of the blow-up time

**概要** As is well-known, solutions of some nonlinear PDEs blow up in finite time. From the viewpoint of numerical analysis, calculating the maximal existence time is of particular interest. So, there are many researches about methods of calculating maximal existence time numerically. In particular, there are many such researches for nonlinear parabolic equations. Recently, Cho proposed an explicit finite difference scheme that can approximate the maximal existence time for a nonlinear wave equation. However, the convergence of Cho's scheme, which is a crucial part of the theory, is open at present. In this paper, we propose a linear implicit scheme for nonlinear wave equations. We show that our scheme can be proven to be convergent and can calculate the numerical maximal existence time.

- 54 内海 晋弥 (早大理工) 時間刻みが小さい時の特性曲線有限要素解の挙動 ..... 15  
 田端正久 (早大理工)  
 Shinya Uchiumi (Waseda Univ.) Behavior of characteristics finite element solutions for small time incre-  
 Masahisa Tabata (Waseda Univ.) ments

**概要** We study behavior of solutions of two characteristics finite element schemes for small time increments. Our recently developed scheme free from numerical quadrature is always stable for any time increment. The conventional scheme using numerical quadrature is unstable for time increments of medium size, but it is proved to recover the stability for sufficiently small time increments for each fixed element size  $h$ .

#### 16:00~17:00 特別講演

- 渡部 善隆 (九大情報) 計算機援用証明による Orr-Sommerfeld 問題の安定性・不安定性解析  
 Yoshitaka Watanabe (Kyushu Univ.) Computer-assisted stability and instability proofs for the Orr-Sommerfeld  
 problem

**概要** The Orr-Sommerfeld equation is one of the central equations governing the linearized stability theory of incompressible flows. The Orr-Sommerfeld equation is a non-selfadjoint eigenvalue problem for the eigenpair, and within the frame of linearized stability theory, the flow is stable if the spectrum is located in the right complex half-plane, otherwise unstable.

In this talk, we focus on the case of plane Poiseuille flow and propose a numerical verification method for computing eigenpair enclosures and eigenvalue exclosures for the Orr-Sommerfeld problem. Some verification results confirm the effectiveness of the method. We also note that our principle can be applied to other nonlinear problems including partial differential operators.

## トポロジー

3月15日(土) 第IV会場

## 10:00~12:00

- 1 安部哲哉 (東工大理工) Infinitely many ribbon disks with the same exterior ..... 15  
 Tetsuya Abe (Tokyo Tech) Infinitely many ribbon disks with the same exterior

概要 We construct infinitely many ribbon disks with the same exterior.

- 2 小沢 誠 (駒澤大総合) Dehn surgery and Seifert surface system ..... 10  
 下川 航也 (埼玉大理工)  
 Makoto Ozawa (Komazawa Univ.) Dehn surgery and Seifert surface system  
 Koya Shimokawa (Saitama Univ.)

概要 For a compact connected 3-submanifold with connected boundary in the 3-sphere, we relate the existence of a Seifert surface system with a Dehn surgery along a null-homologous link. As its corollary, we obtain the Fox's re-embedding theorem.

- 3 市原 一裕 (日大文理) Strong cylindricality and the monodromy of bundles ..... 10  
 小林 毅 (奈良女大理)  
 Y. Rieck (Univ. of Arkansas)  
 Kazuhiro Ichihara (Nihon Univ.) Strong cylindricality and the monodromy of bundles  
 Tsuyoshi Kobayashi  
 (Nara Women's Univ.)  
 Yo'av Rieck (Univ. of Arkansas)

概要 A surface  $F$  in a 3-manifold  $M$  is called cylindrical if  $M$  cut open along  $F$  admits an essential annulus  $A$ . If, in addition,  $(A, \partial A)$  is embedded in  $(M, F)$ , then we say that  $F$  is strongly cylindrical. Let  $M$  be a connected 3-manifold that admits a triangulation using  $t$  tetrahedra and  $F$  a two-sided connected essential closed surface of genus  $g(F)$ . We show that if  $g(F)$  is at least  $38t$ , then  $F$  is strongly cylindrical. As a corollary, it is shown that a closed hyperbolic manifold admits only finitely many fibrations over the circle with connected fiber whose translation distance is not one. Similar results were obtained by Saul Schleimer.



- 4 N. Hoffman (Univ. of Melbourne) 3次元双曲多様体の精度保証付き数値計算 ..... 15  
 市原 一 裕 (日 大 文 理)  
 柏 木 雅 英 (早 大 理 工)  
 正 井 秀 俊 (東工大情報理工)  
 大 石 進 一  
 (早大理工・JST CREST)  
 高 安 亮 紀 (早 大 理 工)  
 Neil Hoffman (Univ. of Melbourne) Verified computations for hyperbolic 3-manifolds  
 Kazuhiro Ichihara (Nihon Univ.)  
 Masahide Kashiwagi (Waseda Univ.)  
 Hidetoshi Masai (Tokyo Tech)  
 Shin'ichi Oishi  
 (Waseda Univ./JST CREST)  
 Akitoshi Takayasu (Waseda Univ.)

概要 For a given cusped 3-manifold  $M$  admitting an ideal triangulation, we describe a method to rigorously prove that either  $M$  or a filling of  $M$  admits a complete hyperbolic structure via verified computer calculations. Central to our method are an implementation of interval arithmetic and Krawczyk's Test. These techniques represent an improvement over existing algorithms as they are faster while accounting for error accumulation in a more direct and user friendly way.

- 5 阪 田 直 樹 (広 島 大 理) 双曲的ファイバー二橋絡み目補空間における標準的分割 ..... 10  
 Naoki Sakata (Hiroshima Univ.) Canonical decompositions of hyperbolic fibered two-bridge link complements

概要 By the work of Epstein–Penner and Weeks, every finite-volume cusped hyperbolic manifold is decomposed in a canonical way into ideal polyhedra, called the canonical decomposition. Jørgensen showed that the canonical decompositions of once-punctured torus bundles over  $S^1$  are “layered” triangulations. In this talk, we prove that the canonical decompositions of hyperbolic fibered two-bridge link complements are “layered” triangulations. To prove this result, we use A’Campo’s criterion for detecting fiberedness.

- 6 風 呂 川 幹 央 (広 島 大 理) 一点穴開きクラインボトルフックス群のフォード領域の構成 ..... 10  
 Mikio Furokawa (Hiroshima Univ.) A construction of the Ford domains of fuchsian once-punctured Klein bottle groups

概要 Jorgensen gave a complete description of the combinatorial structure of the Ford domains of quasi-fuchsian once-punctured torus groups. In this talk, we give a construction of the Ford domains of fuchsian once-punctured Klein bottle groups by using Jorgensen’s method. We also show that there are quasi-fuchsian once-punctured Klein bottle groups whose Ford domains have quite different nature compared with these of quasi-fuchsian once-punctured torus groups.

- 7 小笠 英 志 (明治学院大)\* 結び目多項式の局所操作公式の新展開 ..... 10  
 Eiji Ogasa (Meiji Gakuin Univ.) New developments of local move identities of knot polynomials

概要 It is well-known the Alexander polynomial  $A(K)$  of 1-links  $K$  satisfies the identity

$A(K_+) - A(K_-) = (t - 1) \cdot A(K_0)$  associated with a kind of local moves of knots. (The Jones polynomial of 1-links satisfies a similar one.)

We found that the  $l$ -Alexander polynomial  $\Delta_l(K)$  of  $n$ -knots  $K$  satisfies some identities associated with some kinds of local moves. The identities are as follows

$$\Delta_l(K_+) - \Delta_l(K_-) = (t - 1) \cdot \Delta_l + 1(K_0)$$

$$\Delta_l(K_+) - \Delta_l(K_-) = (t + 1) \cdot \Delta_{l+1}(K_0)$$

These forms depend on  $l$  and kinds of local moves.

$$\text{Arf} K_+ - \text{Arf} K_- = \{|bP_{4k+2} \cap I(K_0)| + 1\} \bmod 2, \text{ where } I() \text{ is the inertia group and } bP() \text{ the } bP\text{-subgroup.}$$

- 8 金 信 泰 造 (阪 市 大 理) 多項式不変量による結び目のゴルディアン距離の評価 ..... 10  
 森 内 博 正 (近 畿 大 医)  
 Taizo Kanenobu (Osaka City Univ.) Evaluations of Gordian distances of knots by polynomial invariants  
 Hiromasa Moriuchi (Kinki Univ.)

概要 The Gordian distance of two knots is the minimum number of crossing changes needed to transform one into the other. We introduce several criterion using the Jones and HOMFLYPT polynomials. Then making use of them, we improve the table of the Gordian distances between knots with up to seven crossings given by Darcy.

- 9 堀 内 澄 子 (東京女大現代教養) A lattice of virtual knots by crossing changes ..... 15  
 大 山 淑 之 (東京女大現代教養)  
 Sumiko Horiuchi A lattice of virtual knots by crossing changes  
 (Tokyo Woman's Christian Univ.)  
 Yoshiyuki Ohyama  
 (Tokyo Woman's Christian Univ.)

概要 If two virtual knots  $K_1$  and  $K_2$  are transformed into each other by a finite sequence of crossing changes,  $d_G(K_1, K_2)$  denotes the minimal number of times of crossing changes needed to transform  $K_1$  into  $K_2$ . A  $n$  dimensional lattice of virtual knots by crossing changes is the  $n$  dimensional lattice graph which satisfies the following: The vertex set consists of oriented virtual knots and for any two vertices  $K_1$  and  $K_2$ , the distance on the graph from  $K_1$  to  $K_2$  coincides with  $d_G(K_1, K_2)$ , where the distance on the graph means the number of edges of the shortest path which connects the two virtual knots. In this talk, we show that for any given natural number  $N$  and any given virtual knot  $K$ , there exists a  $N$  dimensional lattice of virtual knots by crossing changes with the vertex  $K$ .

## 14:15~16:30

- 10 河村建吾 (阪市大理) Tabulation of the clasp number of prime knots with up to 10 crossings  
 門上晃久 ..... 15  
 (East China Normal Univ.)  
 Kengo Kawamura (Osaka City Univ.) Tabulation of the clasp number of prime knots with up to 10 crossings  
 Teruhisa Kadokami  
 (East China Normal Univ.)

概要 Any knot  $K \subset S^3$  bounds a clasp disk that is an immersed disk whose singularity set consists of only clasp singularity. Then we can define a knot invariant  $c(K)$  called the clasp number. In 1974, T. Shibuya proved that the genus and the unknotting number are lower bounds of the clasp number, that is,  $\max\{g(K), u(K)\} \leq c(K)$ . In this talk, we introduce a characterization of the Alexander module via the clasp disk introduced by K. Morimoto. Moreover, we show that  $\max\{g(10_{97}), u(10_{97})\} < c(10_{97})$ .

- 11 滝岡英雄 (阪市大理) ミュータント結び目のケーブル  $\Gamma$  多項式 ..... 10  
 Hideo Takioka (Osaka City Univ.) The cable  $\Gamma$ -polynomials of mutant knots

概要 The  $\Gamma$ -polynomial is an invariant of an oriented link, which is the common zeroth coefficient polynomial of the HOMFLYPT and Kauffman polynomials. It is known that the HOMFLYPT and Kauffman polynomials, their 2-cable versions, and the satellite versions of the Alexander and Jones polynomials are invariant under mutation. Moreover, it is also known that the 3-cable version of the HOMFLYPT polynomial distinguishes a mutant knot pair. In this talk, we show that the 3-cable version of the  $\Gamma$ -polynomial is invariant under mutation.

- 12 中村拓司 (大阪電通大工) 効果的なフォックス 9-彩色における色の数 ..... 10  
 中西康剛 (神戸大理)  
 佐藤進 (神戸大理)  
 Takuji Nakamura On the number of colors in effective Fox 9-colorings for knots  
 (Osaka Electro-Comm. Univ.)  
 Yasutaka Nakanishi (Kobe Univ.)  
 Shin Satoh (Kobe Univ.)

概要 For a composite  $n$ , we define an effective  $n$ -coloring of knots and give a lower bound  $\log_2 n + 1$  for the minimal number of colors for all effective  $n$ -colorings. In particular, we prove that any effectively 9-colorable knot is represented by a diagram where exactly five colors of nine are assigned to the arcs.

- 13 櫻井みぎ和 (東京女大理) A polynomial invariant and the forbidden move of virtual knots ..... 10  
 Migiwa Sakurai A polynomial invariant and the forbidden move of virtual knots  
 (Tokyo Woman's Christian Univ.)

概要 Satoh and Taniguchi introduced a numerical invariant called an  $n$ -writhe and we can define a polynomial invariant by using the  $n$ -writhe. In this talk, we provide the difference of the values obtained from the polynomials between two virtual knots which can be transformed into each other by a single forbidden move. As a result, we make it possible for many virtual knots to determine the unknotting numbers by forbidden moves.

- 14 田 神 慶 士 (東 工 大 理 工) A categorification of the Miyazawa polynomial ..... 10  
 Keiji Tagami (Tokyo Tech) A categorification of the Miyazawa polynomial

概要 In this talk, we construct a link homology for each stable equivalence class, that is, virtual link by using Bar-Natan's geometric complex and a homotopy quantum field theory (HQFT for short). In particular, if we take a certain HQFT, it is isomorphic to Dye–Kauffman–Manturov's categorification of the Miyazawa polynomial.

- 15 清 水 健 一 (名 大 多 元 数 理) New examples of handlebody-TQFTs ..... 15  
 柴 田 大 樹 (筑 波 大 数 理 物 質)  
 Kenichi Shimizu (Nagoya Univ.) New examples of handlebody-TQFTs  
 Taiki Shibata (Univ. of Tsukuba)

概要 Ishii and Masuoka introduced the braided monoidal category  $\mathcal{T}$  of handlebody tangles. According to their results, a commutative Frobenius algebra in a braided monoidal category  $\mathcal{B}$  yields a  $\mathcal{B}$ -valued handlebody-TQFT, *i.e.*, a braided monoidal functor from  $\mathcal{T}$  to  $\mathcal{B}$ . In this talk, we give a new construction of commutative Frobenius algebras in braided finite tensor categories, which largely extends a construction due to Ishii and Masuoka. As an application, we propose the Dijkgraaf–Witten theory for handlebody-links by using the twisted Drinfeld double quasi-Hopf algebras.

- 16 瀧 村 祐 介 (早 大 教 育)<sup>b</sup> (1, 2) homotopy on knot projections ..... 10  
 伊 藤 昇 (早 大 高 等 研)  
 Yusuke Takimura (Waseda Univ.) (1, 2) homotopy on knot projections  
 Noboru Ito (Waseda Univ.)

概要 We consider Reidemeister move 1, 2 on  $S^2$  and obtain necessary and sufficient condition for two knot projections to transform into each other by these moves.

- 17 瀧 村 祐 介 (早 大 教 育)<sup>b</sup> Strong and weak (1, 3) homotopies on knot projections ..... 15  
 伊 藤 昇 (早 大 高 等 研)  
 谷 山 公 規 (早 大 教 育)  
 Yusuke Takimura (Waseda Univ.) Strong and weak (1, 3) homotopies on knot projections  
 Noboru Ito (Waseda Univ.)  
 Kouki Taniyama (Waseda Univ.)

概要 We consider Reidemeister moves 1, strong 3, weak 3 for knot projections on  $S^2$ . We define equivalence relations that are called weak (1, 3) and strong (1, 3) homotopies. For each equivalence relation, we determine which knot projections are trivialized. We also treat general cases and introduce invariants to classify knot projections.

- 18 野坂 武史 (九大数理) 結び目群の  $SL_2$ -表現空間内の経線と, 体の Milnor–Witt  $K_2$ -群 ..... 15  
 Takefumi Nosaka (Kyushu Univ.) Longitudes in  $SL_2$ -representations of link groups and Milnor–Witt  $K_2$ -groups of fields

**概要** We introduce an arithmetic  $K_2$ -value appearing in longitudes of a link via a  $SL_2$ -representation of the link group. Furthermore we prove the non-triviality, and compute the values for some link groups. In application, we give relatively simple computations of parabolic representations and a state sum formula of their cusp shapes.

#### 17:00～18:00 特別講演

- 野坂 武史 (九大数理) カンドル理論による双線型形式値の低次元位相不変量  
 Takefumi Nosaka (Kyushu Univ.) Low dimensional topological invariants of bilinear forms from quandle theory

**概要** We introduce some low dimensional topological invariants of bilinear forms. The construction for the invariants is based on quandle which is a certain algebraic system, and we define the invariants as “quandle cocycle invariants” of bilinear forms. So the construction is applicable to several low dimensional topological objects: 3-dimensional knots, knotted surfaces, handlebody links in  $S^3$ , surface braids. Furthermore, in knot case, we show that the invariants are, roughly speaking, bilinear forms on twisted Alexander “dual” modules; we hope that it is an interesting problem to analyse topological interpretations of the bilinear forms and to develop their applications.

As an application, we introduce bilinear-invariants of Hurwitz equivalence classes with respect to any group  $G$ . The invariants are constructed from any right  $G$ -modules  $M$  and any  $G$ -invariant bilinear functions on  $M$ . For instance, when  $G$  is the mapping class group of a closed surface,  $M_g$ , we get an invariant of Lefschetz fibrations over the 2-sphere. Moreover, the construction can be applied to the quantum representations of level  $k$  derived from the Chern–Simons quantum field theory. In particular, concerning the  $U(1)$ - or  $SU(2)$ -gauge groups, by the help of computers, we can compute many invariants in low fiber-genus case and we find new pairs of non-isomorphic Lefschetz fibrations. Furthermore we see that the invariant does not admit an additivity with respect to fiber sums.

In this talk, we explain the construction for the invariant of bilinear form, and demonstrate our idea to define the invariants of Hurwitz equivalence classes. Furthermore we present some computations.

## 3月16日(日) 第IV会場

## 9:30~11:45

- 19 桐木 紳 (東海大理) Blenders in center unstable Hénon-like families: with an application to  
 L. J. Díaz (PUC-Rio) heterodimensional bifurcations ..... 15  
 篠原 克寿  
 (JST FIRST合原最先端数理モデルプロジェクト)  
 Shin Kiriki (Tokai Univ.) Blenders in center unstable Hénon-like families: with an application to  
 Lorenzo J. Díaz (PUC-Rio) heterodimensional bifurcations  
 Katsutoshi Shinohara (JST FIRST)

概要 We give an explicit family of polynomial maps called center unstable Hénon-like maps and prove that they exhibits *blenders* for some parameter values, which only appear in dimension greater than or equal to 3 and are special type of hyperbolic sets of diffeomorphisms. Using this family, we also prove the occurrence of blenders near certain *non-transverse heterodimensional cycles* under high regularity assumptions. The proof involves a *renormalization scheme* along heteroclinic orbits. We also investigate the connection between the blender and the original heterodimensional cycle.

- 20 佐治健太郎 (神戸大理)\* モラン特異点のイソトピー ..... 10  
 Kentaro Saji (Kobe Univ.) Isotopy of Morin singularities

概要 In this talk, I introduce an equivalence relation called A-isotopy between finitely determined map-germs, which is a strengthened version of A-equivalence. I consider the number of A-isotopy classes of equidimensional Morin singularities.

- 21 伊藤 哲也 (京大数理研) Overtwisted disc in planar open books ..... 10  
 川室 圭子 (Univ. Iowa)  
 Tetsuya Itoh (Kyoto Univ.) Overtwisted disc in planar open books  
 Keiko Kawamuro (Univ. Iowa)

概要 Using open book foliation machinery, we show that an overtwisted disc in planar open books can be put in a topologically nice position. As a corollary, we show that a planar open book whose fractional Dehn twist coefficients along any boundary components greater than one supports a tight contact structure.

- 22 大場 貴裕 (東工大理工) Stein fillings of homology spheres with planar open books ..... 10  
 Takahiro Oba (Tokyo Tech) Stein fillings of homology spheres with planar open books

概要 It is well-known that the complex structure on a compact Stein surface induces a contact structure on the boundary and there is one to one correspondence between the set of contact structures on a given 3-manifold and the set of open books of the same manifold. In this talk, considering Lefschetz fibrations over  $D^2$  obtained from compact Stein surfaces and supporting open books of these boundaries, I will present a necessary and sufficient condition for the boundary of a compact Stein surface to be an integral homology 3-sphere.

- 23 安井 弘一 (広島大理) Partial twists and exotic Stein fillings ..... 15  
 Kouichi Yasui (Hiroshima Univ.) Partial twists and exotic Stein fillings

概要 For a given collection of simple closed curves in a bounded surface that contains certain six curves, after stabilizing these curves and the surface, and adding auxiliary curves to the collection, we construct infinitely many pairwise exotic positive allowable Lefschetz fibrations (PALFs) so that the resulting curves are vanishing cycles of one of the PALFs. As a corollary, we show that topological invariants (fundamental groups, homology groups, boundary homology groups, and intersection forms) of many 4-dimensional compact oriented 2-handlebodies are realized as those of infinitely many pairwise exotic Stein fillings.

- 24 浮田 卓也 (東工大理工) Akbulut–Yasui plug の PALF 構造と plug twist ..... 10  
 Takuya Ukida (Tokyo Tech) PALF structure on Akbulut–Yasui plugs and plug twist

概要 Loi and Piergallini proved that every compact Stein surface admits a PALF (positive allowable Lefschetz fibration) over a 2-disk. Akbulut and Yasui introduced cork twist and plug twist to construct various families of arbitrary many compact Stein surfaces which are mutually homeomorphic but not diffeomorphic. In this talk, we construct an explicit PALF of genus 1 on every Akbulut–Yasui plug and describe monodromies of PALF's on two Stein surfaces related by a plug twist.

- 25 小林 竜馬 (東京理大理工) Lefschetz fibrations with a  $(-1)$ -section and finitely presented groups .. 15  
 門田 直之 (東京理大理工)  
 Ryoma Kobayashi (Tokyo Univ. of Sci.) Lefschetz fibrations with a  $(-1)$ -section and finitely presented groups  
 Naoyuki Monden (Tokyo Univ. of Sci.)

概要 It follows from results of Gompf and Donaldson that every finitely presented group is the fundamental group of the total space of a Lefschetz fibration with a  $(-1)$ -section. In our work, we constructed Lefschetz fibrations with a  $(-1)$ -section whose fundamental groups are a given finitely presented group, by providing genus and monodromy explicitly.

- 26 村上 翔太 (慶大理工) Deformation equivalence classes of surfaces with  $b_1 = 1$  and  $b_2 = 0$  ... 10  
 Shota Murakami (Keio Univ.) Deformation equivalence classes of surfaces with  $b_1 = 1$  and  $b_2 = 0$

概要 Given a real, smooth, closed 4-manifold  $M$ , a primitive problem is to ask whether the number of deformation equivalence classes of surfaces homotopy equivalent to  $M$  is finite. Friedman and Morgan have proven that if  $b_1(M) \neq 1$ , then the number of deformation equivalence classes of surfaces homotopy equivalent to  $M$  is finite except in the case when  $M$  is homotopy equivalent to a elliptic surface whose fundamental group is finite cyclic. The problem remains open for manifolds with  $b_1 = 1$ . In this talk, we will like to prove that if  $M$  satisfies  $b_1(M) = 1$  and  $b_2(M) = 0$ , the number is finite.

- 27 逆井 卓也 (東大数理) Orthogonal decomposition of the Sp-invariant part of the symplectic  
鈴木 正明 (明大総合数理) derivation Lie algebra ..... 15  
森田 茂之 (東大\*・東工大\*)

Takuya Sakasai (Univ. of Tokyo) Orthogonal decomposition of the Sp-invariant part of the symplectic  
Masaaki Suzuki (Meiji Univ.) derivation Lie algebra

Shigeyuki Morita

(Univ. of Tokyo\*/Tokyo Tech\*)

概要 By using a canonical metric on the space of symplectic invariants, we give a detailed structure of the symplectic invariant part of the symplectic derivation Lie algebra of a free Lie algebra.

### 13:30~14:30 特別講演

吉野 太郎 (東大数理)<sup>b</sup> 位相的ブローアップについて

Taro Yoshino (Univ. of Tokyo) On topological blowups

3月17日(月) 第IV会場

### 10:00~12:00

- 28 越野 克久 (筑波大数理物質)\* A hypograph space and its compactification ..... 15  
酒井 克郎 (神奈川大工)  
楊 寒彪 (筑波大数理物質)

Katsuhisa Koshino (Univ. of Tsukuba) A hypograph space and its compactification

Katsuro Sakai (Kanagawa Univ.)

Hanbiao Yang (Univ. of Tsukuba)

概要 Let  $X$  be an infinite, locally connected, compact metrizable space and  $Y$  be a dendrite with an end point  $v$ . For each continuous map  $f : X \rightarrow Y$ , we define the hypograph  $\downarrow f = \bigcup_{x \in X} \{x\} \times [v, f(x)]$ , where  $[v, f(x)]$  is the unique arc from  $v$  to  $f(x)$  in  $Y$ . Then we can regard  $\downarrow C(X, Y) = \{\downarrow f \mid f : X \rightarrow Y \text{ is a continuous map}\}$  as the subspace of the hyperspace  $Cld(X \times Y)$  of non-empty closed sets in  $X \times Y$  endowed with the Vietoris topology. Let  $\overline{\downarrow C(X, Y)}$  be the closure of  $\downarrow C(X, Y)$  in  $Cld(X \times Y)$ . In this talk, we show that the pair  $(\overline{\downarrow C(X, Y)}, \downarrow C(X, Y))$  is homeomorphic to  $(\mathbf{Q}, \mathbf{c}_0)$ , where  $\mathbf{Q} = [0, 1]^{\mathbb{N}}$  is the Hilbert cube and  $\mathbf{c}_0 = \{(x_i)_{i \in \mathbb{N}} \in \mathbf{Q} \mid \lim_{i \rightarrow \infty} x_i = 0\}$ .

- 29 小林 竜馬 (東京理大理工) L-S categories of vector bundles over projective spaces ..... 15  
Ryoma Kobayashi (Tokyo Univ. of Sci.) L-S categories of vector bundles over projective spaces

概要 James calculated  $\text{vecat}(k\gamma_{\mathbb{R}})$ , the L-S category of  $k\gamma_{\mathbb{R}}$ , for  $k = 2^t$  and  $\gamma_{\mathbb{R}}$ , the canonical line bundle over the  $(2^t - 1)$ -dimensional real projective space. In this work, we calculated  $\text{vecat}(k\gamma_{\mathbb{R}})$  for integers  $k$  and  $\gamma_{\mathbb{R}}$ , the canonical line bundle over real projective spaces. We also calculated  $\text{vecat}_{\mathbb{F}}\xi$ , the L-S category of  $\xi$  as an  $\mathbb{F}$ -vector bundle, where  $\mathbb{F} = \mathbb{R}$  or  $\mathbb{C}$ , for  $\xi$ , multiple Whitney sums of canonical line bundles over complex and quaternion projective spaces.



- 30 原 口 忠 之 (環 太 平 洋 大) 数値的生成空間の圏へのモデル構造の導入とその一般化について ..... 15  
 Tadayuki Haraguchi About introduction and geralization of a model structure on the cate-  
 (Internat. Pacific Univ.) gory of numerically generated spaces

概要 Let  $\mathbf{C}$  be a coreflective subcategory of a cofibrantly generated model category  $\mathbf{D}$ . In this talk we introduce that under suitable conditions  $\mathbf{C}$  admits a cofibrantly generated model structure which is left Quillen adjunction to the model structure on  $\mathbf{D}$ . As an application, we give that the category of numerically generated spaces admit a cofibrantly generated model structure which is Quillen equivalent to the standard model structure on the category  $\mathbf{Top}$  of topological spaces.

- 31 百 瀬 康 弘 (信州大総合工) 擬スキームイドと Baues–Wirsching コホモロジーについて ..... 15  
 沼 田 泰 英 (信 州 大 理)  
 Yasuhiro Momose (Shinshu Univ.) On quasi-schemoids and the Baues–Wirsching cohomology  
 Yasuhide Numata (Shinshu Univ.)

概要 A quasi-schemoid is a generalization of an association scheme, and a schemoid algebra is an analogue of the Bose–Mesner algebra for an association scheme. Our aim is to study quasi-schemoids and schemoid algebras via cohomologies. We describe the Baues–Wirsching cohomology of some poset, and apply the description to some example of schemoids.

- 32 森 谷 駿 二 (京 大 理) On semi-direct product of little  $n$ -cubes spaces ..... 15  
 Syunji Moriya (Kyoto Univ.) On semi-direct product of little  $n$ -cubes spaces

概要 I talk about semi-direct product of little  $n$ -cubes spaces. This is inspired by a result of P. Salvatore which states existence of some twist on operadic structures on the space of long knots and their variants.

- 33 森 谷 駿 二 (京 大 理) Homology of long knots and multiplicative formality ..... 15  
 Syunji Moriya (Kyoto Univ.) Homology of long knots and multiplicative formality

概要 I talk about homology of spaces of long knots and multiplicative formality of little  $n$ -cubes operads

- 34 宮 内 敏 行 (福 岡 大 理) Determination of the 2-primary components in 32-stem unstable homo-  
 向 井 純 夫 (信 州 大\*) topology groups of spheres ..... 10  
 Toshiyuki Miyauchi (Fukuoka Univ.) Determination of the 2-primary components in 32-stem unstable homo-  
 Juno Mukai (Shinshu Univ.\*) topology groups of spheres

概要 We determine the 2-primary components in 32-stem unstable homotopy groups of spheres  $\pi_{n+32}^n$  for  $n \geq 9$ . This work begins with Toda: *Composition methods in the homotopy groups of spheres*, *Ann. of Math. Studies*, 49(1962) and was relayed by Mimura, Mori and Oda. Oda: *Unstable homotopy groups of spheres*, *Inst. Adv. Res. Fukuoka Univ.* 44(1979) determined  $\pi_{n+32}^n$  for  $2 \leq n \leq 8$ .

**14:15~15:15**

- 35 神 島 芳 宣 (首都大東京理工) Complex contact structure on nilmanifolds ..... 10  
 田 中 晃 (首都大東京理工)  
 Yoshinobu Kamishima Complex contact structure on nilmanifolds  
 (Tokyo Metro. Univ.)  
 Akira Tanaka (Tokyo Metro. Univ.)

**概要** We study complex contact similarity geometry  $(G, X)$  consisting of a complex nilpotent Lie group  $X$  with invariant complex contact structure and  $G$  is a transitive group of similarity transformations. A manifold locally modelled on  $(G, X)$  is said to be a complex contact similarity manifold. Among them, there exist an infranilmanifold and an infra-Hopf manifold. We give a classification theorem on complex contact similarity manifolds. Our examples are different from those known previously as the complex Boothby–Wang fibration or the twistor fibration.

- 36 須 山 雄 介 (阪 市 大 理) Primitive なベクトルの列の回転数 ..... 10  
 Yusuke Suyama (Osaka City Univ.) Rotation number of primitive vector sequences

**概要** A vector in  $\mathbb{Z}^2$  is called primitive if its components are relatively prime. We give a formula on the rotation number of a sequence of primitive vectors around the origin.

- 37 須 山 雄 介 (阪 市 大 理) Quasitoric でない toric manifold の例 ..... 10  
 Yusuke Suyama (Osaka City Univ.) Examples of toric manifolds which are not quasitoric manifolds

**概要** It is known that if a toric manifold is projective or has complex dimension  $n \leq 3$ , then it is a quasitoric manifold. We show that there are infinitely many toric manifolds which are not quasitoric manifolds for any complex dimension  $n \geq 4$ .

- 38 畑 中 美 帆 (阪 市 大 理) 位相的トーリック多様体の貼り合わせによる構成法 ..... 15  
 Miho Hatanaka (Osaka City Univ.) Gluing construction of topological toric manifolds

**概要** A topological toric manifold is a smooth manifold of even dimension with effective smooth action of a complex torus, having an open dense orbit, and locally equivariantly diffeomorphic to a smooth representation space of the complex torus. The notion of topological toric manifolds was introduced by Ishida–Fukukawa–Masuda as a topological analogue of toric manifolds. They construct topological toric manifolds by generalizing the quotient construction in toric geometry. In this talk, I am going to construct topological toric manifolds by generalizing the gluing construction in toric geometry.

**15:45~16:45 特別講演**

- 原 田 芽 ぐ み (McMaster Univ.)\* Okounkov bodies and toric degenerations  
 Megumi Harada (McMaster Univ.) Okounkov bodies and toric degenerations

## 無 限 可 積 分 系

3月17日(月) 第VIII会場

10:00~11:30

- 1 D. K. Matsumoto (早大基幹理工) Idempotent Yang–Baxter Maps ..... 10  
 Diogo Kendy Matsumoto (Waseda Univ.) Idempotent Yang–Baxter Maps

概要 In this talk, we introduce a way to construct idempotent Yang–Baxter maps by using an algebraic system that contain the distributive lattice as a special case.

- 2 伊藤 哲也 (京大数理研) Generic quantum braid representations and Garside theory ..... 15  
 Tetsuya Itoh (Kyoto Univ.) Generic quantum braid representations and Garside theory

概要 We show that generic quantum representations of the braid groups nicely reflect the dual Garside structure of braid groups, a combinatorial structure of braids producing a nice normal form. In particular, we show that generic quantum representations are faithful.

- 3 松本 拓也 (Utrecht Univ.) 中心拡大された  $\mathfrak{sl}(2|2)$  リースーパー代数に基づくヤンギアン代数のドリ  
 A. Molev (Univ. of Sydney) ンフェルト実現 ..... 15  
 Takuya Matsumoto (Utrecht Univ.) The Drinfeld realization of the Yangian algebra associated with the  
 Alexander Molev (Univ. of Sydney) centrally extended  $\mathfrak{sl}(2|2)$  Lie superalgebra

概要 The Lie superalgebra  $\mathfrak{sl}(2|2)$  is known as the only superalgebra which allows two dimensional central extensions. This algebra and the associated Yangian symmetries appear in the important integrable models such as one-dimensional Hubbard model and the AdS/CFT spin-chain model. In this talk, we propose the Drinfeld second realization based on the Levendorskii's realization, which allows us to introduce the coproduct structure of the Yangian. We also have classified the finite dimensional irreducible representations of the centrally extended superalgebra  $\mathfrak{sl}(2|2)$  by using technique of the Michelsson-Zhelobenko algebra, where we have found that atypical modules which is longer than that of  $\mathfrak{sl}(2|2)$  but shorter than the typical modules of  $\mathfrak{sl}(2|2)$ .

- 4 山根 宏之 (富山大理工)\* Irreducible representations of generalized quantized algebras ..... 15  
 S. Azam (Univ. of Isfahan)  
 M. Yousofzadeh (Univ. of Isfahan)  
 Hiroyuki Yamane (Univ. of Toyama) Irreducible representations of generalized quantized algebras  
 Saeid Azam (Univ. of Isfahan)  
 Malihe Yousofzadeh (Univ. of Isfahan)

概要 We give a list of the finite dimensional (graded) irreducible representations of generalized quantized algebras.

- 5 竹 山 美 宏 (筑波大数理物質) A discrete analogue of periodic delta Bose gas and affine Hecke algebra ..... 15  
 Yoshihiro Takeyama A discrete analogue of periodic delta Bose gas and affine Hecke algebra  
 (Univ. of Tsukuba)

**概要** We consider an eigenvalue problem for a discrete analogue of the Hamiltonian of the non-ideal Bose gas with delta-potentials on a circle. It is a two-parameter deformation of the discrete Hamiltonian for joint moments of the partition function of the O’Connell–Yor semi-discrete polymer. We construct the propagation operator by using integral-reflection operators, which give a representation of the affine Hecke algebra. We also construct eigenfunctions by means of the Bethe ansatz method. In the case where one parameter of our Hamiltonian is equal to zero, the eigenfunctions are given by specializations of the Hall–Littlewood polynomials.

#### 14:15~15:00

- 6 林 達 也 (青学大理工) 非対称な可換微分作用素対 ..... 15  
 Tatsuya Hayashi Non-symmetric commuting differential operators  
 (Aoyama Gakuin Univ.)

**概要** The Calogero–Moser–Sutherland (CMS) models are well known as completely integrable quantum models. For these models, the operators of such models are invariant under the action of some Weyl groups. On the other hand, it is known that there exist deformations of the CMS models which are not invariant under the action of Weyl groups. In this research, we investigate deformations of the CMS models associated with the root system of B2 type. In this case, if certain coupling constants are one or two, then it is known that there exist non-symmetric deformations of CMS models. When some of coupling constants are set three, we construct a completely integrable differential operator.

- 7 高 崎 金 久 (京大人間環境) 位相的弦理論における一般化された Ablowitz–Ladik 階層 ..... 20  
 Kanehisa Takasaki (Kyoto Univ.) Generalized Ablowitz–Ladik hierarchy in topological string theory

**概要** Last year, I reported that a modified melting crystal model gives a solution of the Ablowitz–Ladik hierarchy. This talk presents a generalization of last year’s result to topological string theory on the so called generalized conifolds. Amplitude functions of this model are related to a special tau function of the 2D Toda hierarchy. The associated factorization problem for the dressing operators  $W, \bar{W}$  can be solved explicitly at the initial time  $t = \bar{t} = 0$ . One can thereby find a precise form of the initial values of the Lax operators  $L, \bar{L}$ . The structure of the initial values shows that this model gives a solution of a generalization of the Ablowitz–Ladik hierarchy.

**15:15~16:15 特別講演**

T. E. Milanov (東大IPMU) Hirota bilinear equations in singularity theory

Todor Eliseev Milanov (Univ. of Tokyo) Hirota bilinear equations in singularity theory

**概要** Motivated by Gromov–Witten theory, Dubrovin and Zhang have introduced a new class of integrable systems parameterized by semi-simple Frobenius manifolds. The hierarchies admit the notion of tau-functions and the problem that I would like to address in my lecture is whether the tau-functions can be characterized by Hirota bilinear equations (HBE). I am working in the settings of singularity theory where K. Saito’s theory of primitive forms can be used to construct a large class of semi-simple Frobenius manifolds. My goal is to give an overview of a general construction, which reduces the problem of constructing the HBE to finding a certain global residue formula. I would like also to describe several cases in which an appropriate global residue formula exists. The main difficulty is hidden in the monodromy representation on the vanishing cohomology and in the generalized root system corresponding to the set of vanishing cycles. Only for very few classes of singularities, such as simple singularities, the above objects are well understood, which in particular allowed us to find a global residue formula. In general, however very little is known and this is probably one of the main motivations to pursue this project. Namely, we would like to understand the role of vanishing cycles, the corresponding period integrals, and the monodromy representation in the Dubrovin–Zhang’s integrable system.

3月18日(火) 第VIII会場

**10:00~11:30**

8 茂木 康平 (岡山量子科学研) 可解格子模型と Grothendieck 多項式 ..... 15

堺 和光 (東大総合文化)

Kohei Motegi

(Okayama Inst. for Quant. Phy.)

Kazumitsu Sakai (Univ. of Tokyo)

Integrable models and Grothendieck polynomials

**概要** We investigate the algebraic structures of a class of quantum integrable models including many particle stochastic processes such as the totally asymmetric simple exclusion process and the totally zero range process. We find that the wavefunctions of the models are equivalent to the Grothendieck polynomials, which are polynomial representatives of Schubert classes in the Grothendieck ring of the Grassmann variety. As applications of this equivalence, we derive a Cauchy formula and orthogonality of the Grothendieck polynomials by using the techniques of quantum integrable models.

9 渋川 元樹 (九大数理) Multivariate circular Jacobi polynomials ..... 20

Genki Shibukawa (Kyushu Univ.) Multivariate circular Jacobi polynomials

**概要** Using analysis on symmetric cones, we introduce some new multivariate orthogonal polynomials which are 2-parameter deformations of the spherical polynomials. These are also regarded as a multivariate analogue of the circular Jacobi polynomials. Furthermore, these weight function coincides with the circular Jacobi ensemble defined by P. Bourgade, et. al [IMRN. 23, (2009)].

- 10 森田 健 (阪大情報) A connection formula of a divergent basic hypergeometric function  ${}_3\varphi_0(a_1, a_2, a_3; -; q, x)$  ..... 15  
 Takeshi Morita (Osaka Univ.) A connection formula of a divergent basic hypergeometric function  ${}_3\varphi_0(a_1, a_2, a_3; -; q, x)$

**概要** We show a new connection formula of a divergent basic hypergeometric function  ${}_3\varphi_0(a_1, a_2, a_3; -; q, x)$ . In the study of connection problems on linear  $q$ -difference equations, the  $q$ -Borel–Laplace resummation methods are powerful tools. We introduce the extended  $q$ -Borel–Laplace transformations to obtain the connection formula.

- 11 国場 敦夫 (東大総合文化) 4面体方程式と  $q$ -振動子表現の量子 R 行列 ..... 15  
 尾角 正人 (阪市大理)  
 Atsuo Kuniba (Univ. of Tokyo) Tetrahedron equation and quantum R matrices for  $q$ -oscillator representations  
 Masato Okado (Osaka City Univ.)

**概要** The intertwiner of the quantized coordinate ring  $A_q(sl_3)$  is known to yield a solution to the tetrahedron equation. By evaluating their  $n$ -fold composition with special boundary vectors we generate series of solutions to the Yang–Baxter equation. Finding their origin in conventional quantum group theory is a clue to the link between two and three dimensional integrable systems. We identify them with the quantum  $R$  matrices associated with the  $q$ -oscillator representations of  $U_q(A_{2n}^{(2)})$ ,  $U_q(C_n^{(1)})$  and  $U_q(D_{n+1}^{(2)})$ .

- 12 柴山 允瑠 (阪大基礎工) 特異点のブローアップによるハミルトン系の可積分性の判定 ..... 15  
 Mitsuru Shibayama (Osaka Univ.) Non-integrability criterion for homogeneous Hamiltonian systems via blowing-up technique of singularities

**概要** It is a big problem to distinguish between integrable and non-integrable Hamiltonian systems. We provide a new approach to prove the non-integrability of homogeneous Hamiltonian systems with two degrees of freedom. The homogeneous degree can be chosen from real values (not necessarily integer). The proof is based on the blowing-up theory which McGehee established in the collinear three-body problem. We also compare our result with Molares–Ramis theory which is the strongest theory in this field.

#### 14:15~15:15 特別講演

- 鈴木 貴雄 (近畿大理工) 高階パインレヴェ方程式とリジッド方程式, 超幾何関数  
 Takao Suzuki (Kinki Univ.) Higher order Painlevé system, rigid system and hypergeometric function

**概要** Recently, higher order generalizations of  $P_{VI}$  has been studied from two viewpoints, similarity reductions of infinite dimensional integrable hierarchies and monodromy preserving deformations of Fuchsian systems. In this talk, we discuss their particular solutions in terms of the hypergeometric functions defined by rigid systems. Among those hypergeometric functions, we can find the classical ones; e.g. Thomae's  ${}_{n+1}F_n$ , Appell's  $F_1, F_2, F_3, F_4$  and Simpson's even-odd family.